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TROLLEY CARS ON THE BROOKLYN BRIDGE.

An additional capacity of about 15,000 passengers an hour in each direction is added to the railway service of the Brooklyn Bridge by the recently built tracks for the Brooklyn surface cars, which will now be enabled to take on and discharge their passengers at the New York terminus. The opening of this service is one of the most important steps that have been taken to relieve the fearful congestion of Greater New York's transit facilities, and will doubtless be greatly appreciated by patrons of the bridge.

The construction methods employed, both for the track and the overhead equipment, are unique and are open to no little criticism. A very heavy flat rail is used, attached to the wooden flooring of the bridge roadway by bolts, the nuts being on the under side of the structure and almost inaccessible. The method of bonding is new and should prove very satisfactory; although in view of the danger to be anticipated from any electrolytic action upon the main bridge cables at their anchorages a return circuit of exceptionally low resistance is absolutely necessary. The overhead construction is amazingly heavy and substantial, but this is rather a good fault. It cannot be said that the gallows-like fixtures adopted add greatly to the beauty of the bridge, or that the practice of mounting poles having a side strain due to a heavy arm on the top of a brick wall is one to be generally commended.

The signal system at the New York terminus, where cars of separate lines are distributed upon four tracks and dispatched in their order, seems to hold out promise of future development after it has been tried in actual operation. It seems somewhat unduly complex and largely unnecessary. This, however, the test of actual operation will best determine.

Far the most interesting question relating to the operation of these cars is the possible effect of electrolysis upon the bridge cables at the points where these enter their anchorages. The resistance of the four cables in parallel is a very small fraction of an ohm, and only a small track resistance is necessary to divert a considerable part of the return current through the bridge. It has already been pointed out in these columns that the best solution of the difficulty would be to maintain the anchorages at the two ends at the same potential by an extraneous method. Unless some such plan is adopted it can hardly be doubted that, with the heavy currents due to the continuous procession of cars climbing up the grade on the New York approach, electrolytic action will soon be manifested. It is to be hoped that the endless trouble which this would involve will be avoided by the simple device suggested.

MULTI-VOLTAGE DYNAMO.

Electrical generating units of large sizes have many advantages over smaller sized units aggregating the same capacity. By increasing the sizes of the units the first cost per horse-power is, as a rule, reduced, the efficiency is increased, the maintenance, depreciation and attendance are reduced and the machines are more readily capable of being direct coupled to their prime movers. In many plants the generating machinery has to be split up into a number of small units on account of the desirability of obtaining a number of different voltages or of supplying a number of different loads, such as elevators and lighting, which must not interfere with each other. In railway service some machines are run at a higher voltage than others in order to supply current over longer feeders with greater drop. In

three-wire lighting systems the same necessity arises, and in isolated plants it is desirable to over compound the lighting load, in which case if a storage battery is used, difficulties arise owing to the increased absorption of power by the storage battery at times of increased load. In general, one of two methods is used for supplying these demands for different voltages, first, the running of separate machines for the different loads, and second, the running of one battery of main generators and supplying the various circuits through different boosters or compensators variously wound to adjust the voltages as desired.

If one direct current generator could be made from which power could be derived at various different and separately adjustable voltages, or from which several circuits could be supplied with different ratios of under and over-compounding, it would supply a long-felt want in all places where the need of various voltages divides generating machinery into units smaller than would otherwise be adopted. Such a dynamo is described in another column of this issue. This machine in appearance resembles very closely the ordinary multipolar constant potential generator, the main distinguishing difference being that the various groups of brushes of the same polarity are not cross connected, but remain independent, each adjacent pair of opposite polarities being separately connected up to independent or partially independent circuits. The pole between the two brushes of one circuit and one adjacent pole of opposite polarity are wound with exciting coils independent of those on the other poles of the machine and by these exciting coils the voltage supplied to the one circuit is adjusted independently of that generated in the rest of the armature. The armature is necessarily either of the ring wound or lap drum wound multi-path type. Strange as it may seem with this simple arrangement, the different circuits are as independent, so far as pressure regulation is concerned, as though they were supplied by independent machines coupled together. It might be thought that the field distortion due to an excessive load under one pair of poles would interfere with the voltage under another, but this is found by experiment not to be the case, the load under one pair of poles being reversible from a maximum generating load to a maximum motor load without affecting materially the voltage on the other circuit fed from the same armature winding.

One of the most interesting possibilities of this machine is its application as a single-winding direct-current motor generator, with adjustable ratio of voltage transformation. By supplying one-half of one circuit of a four-pole machine with power, current may be drawn from the other circuit at any voltage from zero to the maximum available pressure of the machine, dependent only on the field excitation of one pair of poles. With machines of still more poles several independent circuits may be supplied with power at various entirely independent voltages, the machine being available in this way for use in such systems as that of the Leonard motor control, wherein several independently variable voltages are desired on as many independent circuits.

THE MOTOR SUSPENSION PATENT.

The decision of Judge Wheeler in the United States Circuit Court on the infringement suit brought by the General Electric Company against the Walker Company is given in full in another column. The matter apparently does not seem to be entirely settled yet, for, although an opinion in favor of the plaintiff was handed down, the language is such that it leaves an opening for further litigation. It is understood that the Walker Company will appeal the case.

The first paragraph of the decision recites the patent upon which the suit is brought, covering a motor with field magnets, supported in the ordinary manner rigidly on the axle and by springs at some other point, "and carrying the armature shaft upon its pole pieces parallel with the shaft of the driving wheels and connected to them by gearing." Further on the decision recites "and if Sprague's patent was for merely hanging and centering one end of a motor of a carriage upon the axle of the driving wheels and suspending the other by a spring from the body of the vehicle or the truck, it would be shown from that case to be wholly lacking in novelty and void. * * * No one had before, however, hung a field magnet at one end upon the axle of the driving wheels and at the other upon a spring from the body of the car or truck and an armature axle upon the pole pieces of the magnet, parallel with and geared to the axle of the driving wheels for driving a car by a current of electricity." The whole question seems to hinge upon the meaning in the decision of the expression "pole pieces." In Mr. Sprague's original patent the old-fashioned horseshoe-shaped magnetic circuit was used, and the armature was journaled in bearings supported by brackets from the pole pieces, but in the more modern ironclad machines now universally used this construction is out of the question, and the bearings are supported from the main shell of the motor. If by pole pieces the judge meant any part of the field magnet structure the decision means one thing; if he meant strictly what are known in the electrical arts as pole pieces the decision means another thing. In the patent claims cited in the decision the broader term field magnet is used, and the fact that the opinion considers the patent infringed by the Walker motor, in which the support is from the magnet yoke, favors the view that the use of the term "pole pieces" was an unintentional inaccuracy.

THE MONEY VALUE OF BRAINS.

There is a considerable difference of opinion as to the market value of intelligent effort, and in some quarters a disposition to believe it very small. This is especially true in regard to engineering talents and most particularly true in England. A recent issue of the London *Electrician* contained an advertisement addressed to electrical engineers, stating that a chief assistant in the Borough Electrical Engineer's Department of West Ham was wanted. Applicants were required to bring not less than three testimonials, to have had a thorough electrical and mechanical training and to be familiar with high-tension alternating work. It was expressly stated that "the gentleman appointed will be required to devote his whole time to the duties of the office and reside within the borough." For all this the princely remuneration of £130 per annum, or $12.17 per week, was offered.

If this case is a fair index of the value of engineering service in England it is no great matter for wonder that that country is so far behind in electrical progress. Nor is it remarkable that contracts come from there to this country, where there is a more proper recognition of the value of engineering service. A state of things that offers little better than laborer's wages to trained and skilled engineers cannot be productive of a high degree of ability among members of the profession, nor does it offer much incentive to young men to undertake the laborious course of preparation necessary to fit themselves for its exercise. Even in this country, where electrical engineering is notoriously overcrowded, such a rate of wage for such service would be regarded as ridiculous.

It seems that, in England, the rates of payment for engineers are not much more than those for high-class mechanics. There a competent mechanic earns $10 a week; here he earns $21. Yet notwithstanding this great difference, and a further difference against us in the cost of most of the raw materials of manufacture, we can undersell English makers of electrical machinery in their own market. Perhaps the disregard of the money value of brains shown by the Council of the County Borough of West Ham, or the fact that engineers are so cheap thereabouts, may account for this otherwise anomalous fact.

Trolley Car Service on the Brooklyn Bridge.

THE construction of tracks and the operation of the Brooklyn electric surface cars across the great suspension bridge presented a number of difficulties and required some interesting novelties of design and method, which are illustrated below.

The roadway of the bridge consists of two approaches, which are paved with granite blocks laid on a substratum of concrete, and the bridge section proper, which is floored with 4-inch timbers laid on other timbers, the two layers crossing at right angles and being carried upon I beams supported from the main cables. The track construction on the approaches is the standard "Brooklyn Heights" construction, using a 98½-pound 9-inch grooved girder rail, laid upon a concrete foundation, and tied together by 3-inch iron straps. No cross ties are used, as the flanges of the rails approach to within 1 inch of the top of the arches of the large vaults under the roadways.

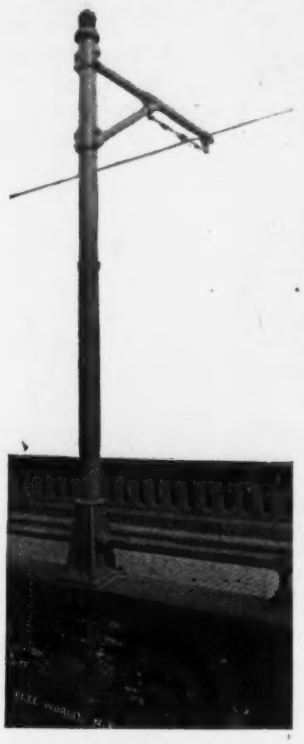
On the floored roadways of the bridge proper, however, a very different style of construction was rendered necessary by the exigencies of vehicle traffic, which required that the tracks should be flush with the roadway and present the least possible obstacle to the wheels of wagons, etc. The rails here are of a peculiar section, practically rectangular, with a groove in the upper surface for the wheel flanges and another groove at one side for the reception of a continuous bonding cable. These rails weigh 93 pounds per yard. They are sunk through the upper planking of the bridge, and are secured to the timbers of the lower tier by countersunk bolts, which pass through the rails at their grooved parts. At the joints the rail ends are beveled off at an angle of 45°, and are secured by two bolts in each to a sole plate, 8 x 24 inches, which is in turn bolted to the lower timbers of the bridge flooring.

Bonding is effected by a continuous copper cable of 175,000 circular mils section laid in the side groove of the rail. Near each rail end a copper strip is brazed to the rail and its ends wrapped over the cable and soldered to it. At the rail joints the cable is led out of its slot and looped around the outer edge of the sole plate.

EAST BOUND CAR ON NEW YORK APPROACH.

The overhead construction is of the most remarkable solidity. The trolley wire, of "figure eight" cross section, is supported on flexible pole brackets, spaced only 37 feet 6 inches apart. On the approaches it was necessary to mount the iron poles carrying these brackets on the top of a low brick wall separating the roadway from the cable car tracks. The pole is set in a cast iron base, which is mounted upon the coping of the wall and secured by four long bolts to an iron plate extending through the wall about 2 feet below the coping. On the bridge structure proper the brackets are attached to short poles set in similar cast bases, which are bolted directly to the ironwork of each fifth member of the bridge trusses.

At the three expansion joints in the three spans of the bridge the tracks are scarfed, a few feet of flexible cable spanning the joint. The trolley wire is carried across the expansion joints by two bronze links, which slide upon one another, a loop of flexible cable taking the greater part of the current.

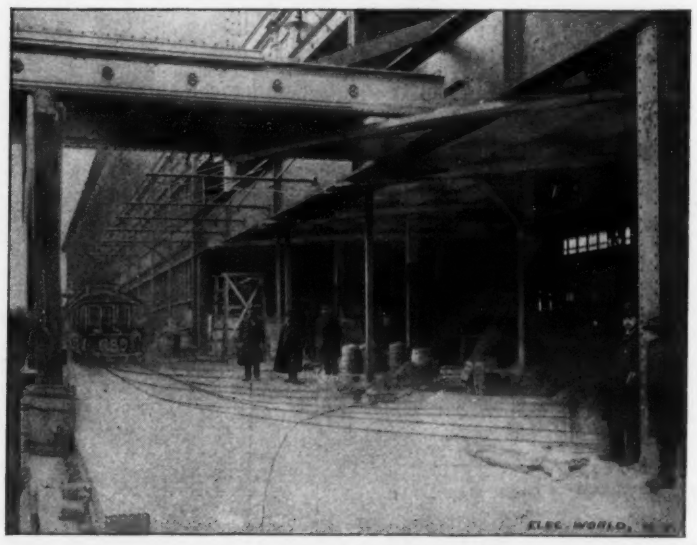


POLE MOUNTED ON BRICK WALL. NEW YORK APPROACH.

The feeder cables are eight in number, each of 500,000 circular mils, and are carried on heavy glass insulators mounted on small brackets inside the through trusses in which the cable cars run. Seven of these cables are positive feeders, while one of them acts in conjunction with the rails and rail cables as a return feeder.

At the New York end of the bridge at the street level there are four cross-over tracks, so that cars of the different lines that will use the bridge may be distributed properly. The switches from the west-bound track on the north side of the bridge will be electrically controlled from a signal and switch box mounted under the western end of the huge plate girder which spans the four in-going loop tracks and sustains the superstructure of the terminus. It is interesting to note that this girder and its companion at the opposite side of the station are among the largest of their kind in use, being 5 feet deep and 98 feet long.

The mechanism for controlling the switches and signals will be very ingenious. The track switches are of the well-known variety made by the New York Switch and Crossing Company, and will be electrically controlled by interlocking electric switches in the signal box. At the western terminus of the roadway, just before the straight track divides into its four cross-over branches, will be mounted a signal consisting of four transparent numbers, illuminated by 32-cp lamps, to designate to the motorman which cross-over track he is to take, and three lights, red, green and white. The red light will be normally shown and the numbers normally dark. When the proper switches have been set for an approaching car the red light is extinguished, the green light shown, and the appropriate track number indicated. As soon as the car passes the signal its trolley closes a contact and diverts a portion of the line current into magnets upon the signal switches in the signal box, restoring these to the normal

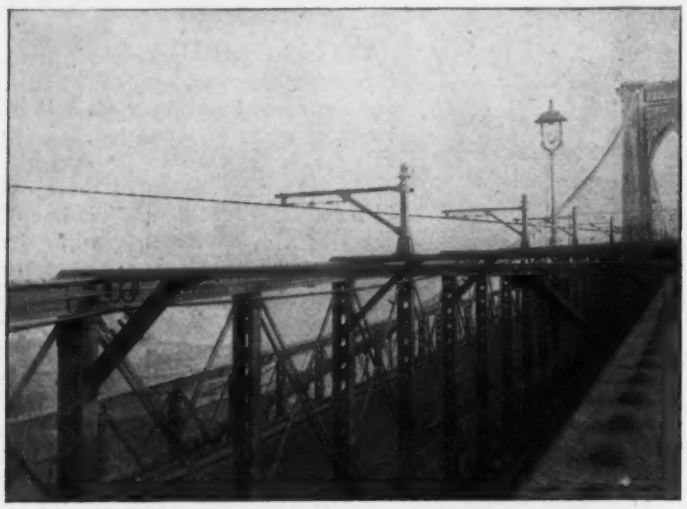


CROSS-OVER LOOPS ON IN-BOUND TRACK. NEW YORK SIDE.

position for all numbers dark and the red light shown. For the present the white light signals will not be used.

Above each of the four out-going cross-over tracks will be located a signal consisting of a red light, a green light and a bell. The signal for a car to start will be the extinction of the red light, the lighting of the green light, and the tapping of the track number by the appropriate bell.

It is expected to maintain a headway of fifteen seconds with a speed



Bracket Arm Construction on Bridge Proper.

of 7 miles per hour, thus keeping the cars a little over 100 feet apart. All the various Brooklyn lines running to the bridge terminus in that borough will use these tracks, the cost of the work of construction having been divided among them. Power for the bridge section will be furnished by the Kent avenue power house of the Brooklyn Heights Railway, whose engineer of track construction, Mr. J. C. Brackenridge, designed and supervised the new arrangements for bringing the Brooklyn trolley cars to New York.

An Electro-Pneumatic Transmission.

A unique transmission plant has recently been installed at Ely, Nev., for the Chainman Mining Company, by the Westinghouse Construction Company, and is described as follows by the *Journal of Electricity*.

Water for the operation of the plant is taken from a spring whence it flows through 1½ miles of ditching and 1800 feet of 24-inch slip joint pipe to the power house, where it is applied to a 5-foot tangential wheel under a head of 500 feet. Direct coupled to the water wheel is a 120-kw Westinghouse two-phase generator supplying wires leading to the mines, not quite 3 miles distant. At the mines the circuit is led through a switchboard possessing no distinctive features to a 150-hp Westinghouse two-phase induction motor, which drives a duplex air compressor, compressing air into three receivers, each measuring 12 feet in length by 5 feet in diameter.

It is from these receivers that air is taken for the operation of all the machinery about the mine. In detail, this consists of one 60-hp hoist, driven by two 10 x 12 engines; one 10-stamp mill, driven by a 10 x 30 Corliss engine; a cyanide plant, driven by an 8 x 24 Corliss engine; and two 6 x 12 simple engines which drive the rock breakers, the concentrators and the electric light plant. The compressed air is all reheated before being used, and for this purpose there are three reheaters, consuming one-half a cord of wood daily.

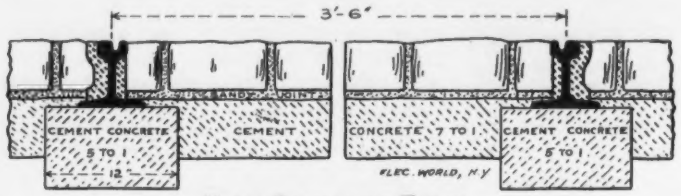
It should be understood that for all practical purposes the generator is rigidly connected to the air compressor, as there is no device installed whereby the motor may be switched off or on by any variation in the pressure of air in the receiver. Instead, however, three signal circuits are carried from the receivers to the power house and by means of these, the burning of a red incandescent lamp indicates that the pressure of air in the receiver is above normal: the burning of a green lamp shows that the pressure is too low, while the burning of a white lamp signifies that the normal pressure prevails. The station attendant varies the speed of the generator according to the signals received, thereby controlling the compressor as required.

Recent Electrical Tramway Construction in England—II.

BY HAROLD LOMAS.

BRISTOL.

Referring to the individual systems, that at Bristol has been running successfully since it was opened, in 1895. The illustration shows that the poles are ornamental, and the erection of the trolley wire was carried out in the most thorough way. The rails are bedded on concrete, 6 inches thick, extending the full length of the tramway, and are connected by four cross ties to each 30 feet of length. These ties are flat steel bars 2 inches by three-eighth-inch, with two nuts at each end, bolted through the web of the rail.



Cross Section of Track.

The Chicago bond has been used and no trouble whatever has been experienced from electrolysis.

The conditions are rather severe for mechanical traction, the steepest grade being 1 in 15, and the sharpest curve of 30 feet radius. The poles are of steel, made in three lengths, of different diameter, the joint between any two sections being made by slipping one tube over the other and rolling them together by special machinery.

The insulators are of the West End type, the insulating material being Ætna. In the power house Willans engines were first laid down, driving by rope Thomson-Houston generators. The engines were, however, replaced by horizontal compound McIntosh & Seymour engines.

The electric trains are very popular in Bristol, and not only has an extension been made, but further extensions are asked for, and would be very popular with the inhabitants; unfortunately, however,

Erecting Poles, Bristol.

the tramways company cannot see its way to accept the conditions that the council would like to impose under the purchase clause of the tramways act. This is a striking instance of how injurious that clause is to future development.

DUBLIN.

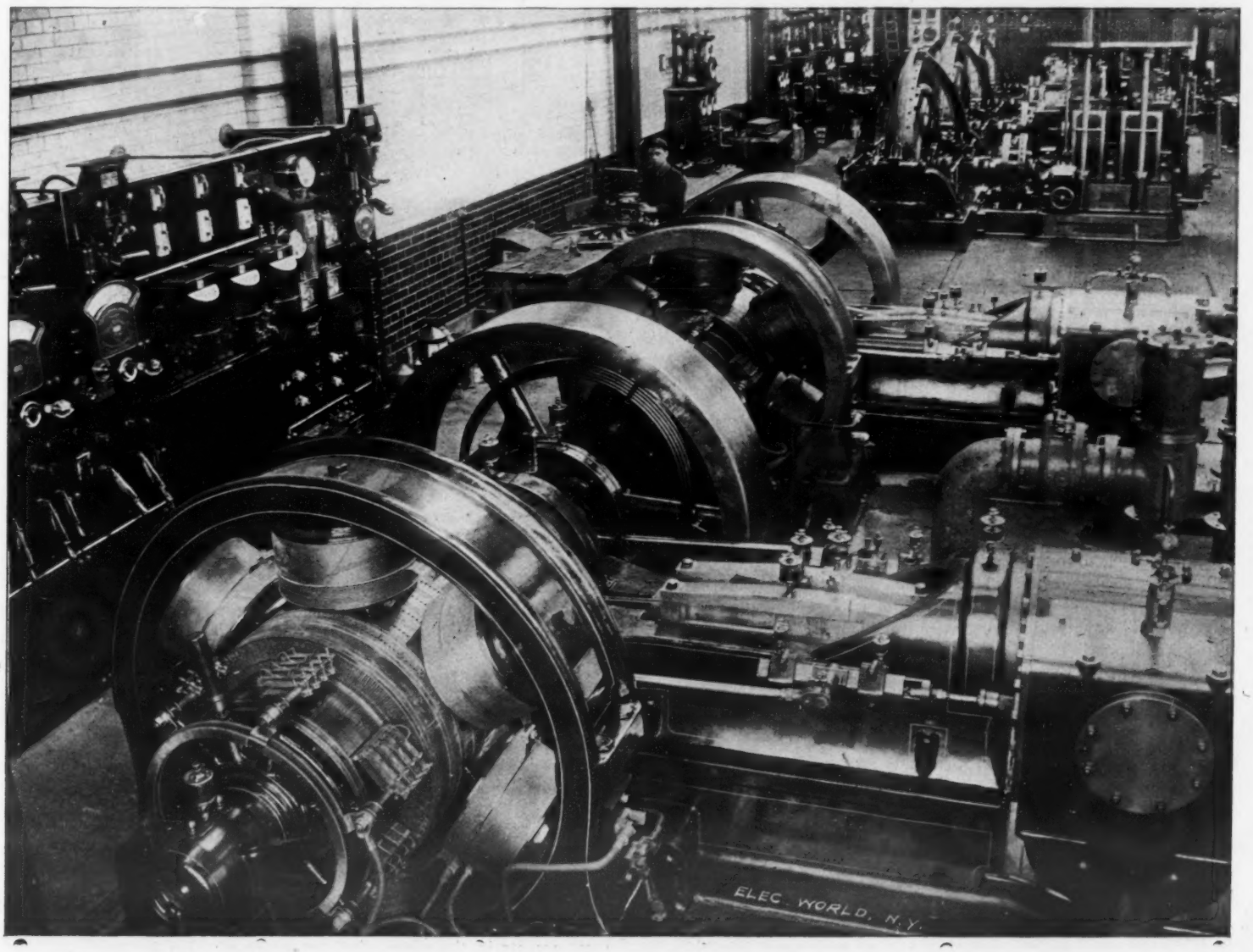
The installation here is interesting as affording the only system so far constructed with a three-phase alternating station. The first line, which starts in South Dublin and extends in a southeasterly direction for 11 miles, was opened in March, 1896. In view of future extensions in Dublin and on account of the property owned there it was deemed advisable to have the power house in Dublin, but in order to conform to the Board of Trade regulations it was found quite impossible to supply direct current. Hence a mixed system was laid down, the part immediately surrounding the power house being supplied with direct-current and a three-phase alternating current being supplied to three-phase synchronous motors coupled to direct-current generators, situated at sub-stations, one in the centre of the line and the other at the far end.

This is a striking instance of how far the Board of Trade rules can influence the system to be laid down. Quite recently, in October last, another portion of the line was completed, which runs from the north of Dublin to Dolly Mount. This line has its own power station equipped with McIntosh and Seymour engines direct coupled to General Electric generators. These two lines are now being connected and eventually all the Dublin tram lines will be electrically operated, the total length amounting to more than 200 miles. The contractor for the electrical plant is the British Thomson-Houston Company.

STRINGING TROLLEY WIRE.

LEEDS.

This is the first of the municipal tramways, the corporation calling in Dr. John Hopkinson as consulting engineer. As long ago as 1890 the Thomson-Houston Company equipped a line having a length of 5½ miles. The Leeds tramways in 1894, however, were bought by the Council under the tramways act and they eventually determined to have electric traction on other routes. There are several interesting points, among which are the extremely solid track laid down and the battery sub-station employed to steady the load.



GENERATOR ROOM AT DOVER.

The solidity of the track is rather a feature of English construction, and it is an open question whether the tendency is not to make it too rigid. In this case a concrete bed is laid at an average depth of 13 inches. On this foundation, rails, weighing 100 pounds per yard, are placed, the rail ends being joined by sole plates and also by fish plates. The bonding was done with the Chicago bond, which has been very largely used in England. There is also some probability of the Edison-Brown plastic bond being tried.

At the power house there are four generators divided into two pairs, each rope driven from one cross compound horizontal engine built by Messrs. Fowler & Co. The field magnets of the generators are provided with a switch such that the series coil can be quite cut out or the winding on each limb be put in series or parallel. The machines are provided with the usual automatic devices and are handled from a plug board such that any or all the generators can supply any or all the feeders. The line itself is in the form of an L, the power house being at the corner, with the two batteries near the extreme ends of the L and distant 1½ to 1¼ miles respectively. Five feeders proceed from the power house, three of which are concentric and feed into the line, the other two being single and going straight to the batteries, which are provided with charge and discharge switches. This line has been so recently installed that it is too early yet to get figures as to the maintenance of the batteries or their value as equalizers of the generator load.

DOVER.

This, the second municipal line, was formally opened on August 27, 1897. The city is an important watering place on the south coast, and the line, which is quite short at present, ought to have a large traffic.

The prime movers consists of two 100-kw horizontal compound McIntosh & Seymour engines coupled to Thomson-Houston four-pole generators. This plant was laid down by the Dover Electricity Supply Company in the same building with the lighting plant, the accompanying illustration showing the alternators in the background. A motor generator of 30-kw capacity has also been installed, which can either be driven from the alternating plant and give the tram voltage at hours of light service, or during the day can be driven from the tram voltage and supply the lighting mains. The terms the corporation accepted were a minimum of 160,000 Board of Trade units at 3d. per unit and any amount in excess of 240,000 Board of Trade units at 2¾d. per units and any amount in excess of 360,000 Board of Trade units at 2¼d. per unit. The total length of the line is only 3.5 miles, and no doubt the comparatively small current had much to do with the acceptance by the corporation of these high prices. The result of experience has shown that with a station of average size current can be generated at a works cost of a penny per unit and frequently less.

Applications for tramways are very numerous all over the country. Besides these mentioned Douglas, Hartlepool and Coventry, with others, have tramways, and extensions are in progress at Fleetwood and in North Staffordshire. Plymouth and Glasgow have recently closed contracts, and Cork (Ireland), Norwich, Hull and Sheffield are a few of those that will shortly be equipped.

Both the City and South London and the Liverpool overhead have been running for some years, and both are financially successful, the latter being especially comfortable for traveling, thus proving that England has done pioneer work in heavy electric traction.

In England the effect of the Central London Underground will be of the utmost importance, in that if that be successful it will be the forerunner of many others. The opportunity for such work about London is enormous, as with the exception of the hansom the means of transit about London are the reverse of rapid, and the suburban railway traffic is crowded to excess, making punctuality well nigh impossible. In the city itself electric traction has already been talked of for the existing underground roads, which consist of a complete loop, generally called the inner circle, from which there run out to the suburbs branch lines which are not underground. The inner circle itself passes on the south side through the very heart of the city, and on the north side makes communication with the termini of the main trunk lines. On this circle there are twenty-six stations, spaced at average distance of three-quarters of a mile apart. At present the trains take seventy minutes to run around the loop, and run at intervals of ten minutes, the actual service on most of the circle being, however, considerably greater than this, owing to the district or suburban trains, which run on the same tracks.

No better field for the application of an electric system could well be imagined as at present the smoke is an intolerable nuisance, the service is tediously slow, and it is not a striking success from a commercial point of view; such an equipment would afford the thin edge of the wedge for equipping the suburban lines. The power house that would be necessary for such a service affords most fascinating speculation, and the special developments that must ensue in an equipment of this kind will be most interesting and instructive, both to our own and other engineers.

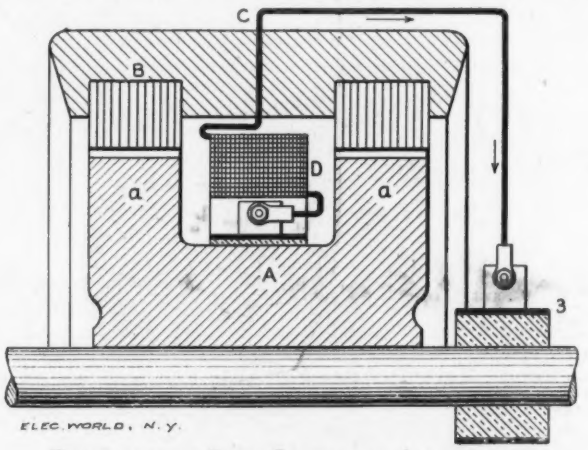
There can be little doubt that the time when suburban steam traffic will be electrically handled is rapidly approaching, and from that there will follow on the busy English roads electrically equipped trunk lines.

A Self-Exciting Alternator without Commutation.

In a recent number of *L'Eclairage Electrique*, Mr. J. L. Routin describes a method of obtaining the excitation current for alternators without the use of exciters or rectifiers of any sort.

The application particularly described is that of an inductor alternator of the type shown in the accompanying diagram. Here *A* represents the rotor with polar terminals, *a a*, revolving inside the fixed magnetic return, *B*, on the laminated annular projections of which the induced coils are wound. The poles may be axially in line with each other, or staggered, and the machine may be either single or multiphase. The line *C* shows diagrammatically the course of the conductors in which the exciting current is generated by the unipolar action of the rotating magnetic field in the fixed magnetic yoke *B*. This conductor, *C*, leads from brushes bearing on an external collector ring shown at the right hand end of the shaft, through the core *B*, to and through the field winding *D*, and thence to an internal collector ring on the rotor *A*, the two collector rings being connected either by an insulated conductor or the iron mass itself.

The voltage generated by this unipolar induction is, of course,



Diagrammatic Cross-Section of Alternator.

very small, but as pointed out by Mr, Routin, it is easy to put in a large number of such conductors distributed around the ring and bearing on a plurality of brushes with ample bearing surface on the collector rings. There is no reason why the field coil should not consist of a very low resistance winding or set of windings, each independently connected with one of the conductors, *C*. The chief objections which may be foreseen in this device are, first, the difficulty of controlling the field from a switchboard at any distance, and second, the difficulty of making sliding contacts on the collector rings of sufficiently low resistance to prevent considerable disturbances of the field excitation with the slightest eccentricity or roughness of the rings.

Mr. Routin describes tests made at the Oerlikon works of Messrs. Brown, Boveri & Co. of a three-phase inductor generator, the size of which is unfortunately not given. The tests, however, were made with separate excitation, the unipolar current induced being passed through a rheostat and its quantity and pressure measured. With a current of 26 amperes at 52 volts through the field coil there was available in the unipolar circuit 420 amperes at 2.6 volts. Obviously the watts generated in the unipolar circuit were in this case practically equal to those necessary for the field excitation, so that the device appears to be of considerable promise if the collector ring disturbances are not too serious. The arrangement would be highly desirable in small isolated plants where the necessity of a separate exciter operates against the use of alternating currents in the place of direct currents; also for synchronous motors for which direct current field excitation is necessary.

A Multi-Voltage Direct-Current Dynamo.

For the generation of direct currents at various different and independently variable voltages, a single dynamo has never been considered available. The designers of such machines of the multipolar type have gone on the principle that it is absolutely necessary to make the flux through any one pole as nearly equal as possible to that through all the other poles of the machine, and in truth this is necessary where a multi-circuit winding is used with external cross-connections between the brushes. By severing these cross connections, however, and obeying certain precautions, it has been shown by Mr. S. W. Rushmore to be possible to run such a machine generating a different voltage under each different pair of poles, these voltages being independently variable between the widest limits, and the respective loads being also independently variable between wide limits, both positive and negative, without serious interference between the various circuits. Experiments of this kind have been carried on in the past mainly with the view of designing single machines for the supply of three-wire circuits or similar work, but without any marked success. The tests described below show that the different poles of a multipolar generator can be made to generate current in the one armature winding at as many different independently variable voltages as there are pairs of field poles, so that the one generator is practically the equivalent of a group of separate generators, as far as independence of regulation and absence of mutual interference are concerned.

The accompanying illustration (Fig. 1) shows a four-pole machine now in service at the Rushmore Works, the armature being of the

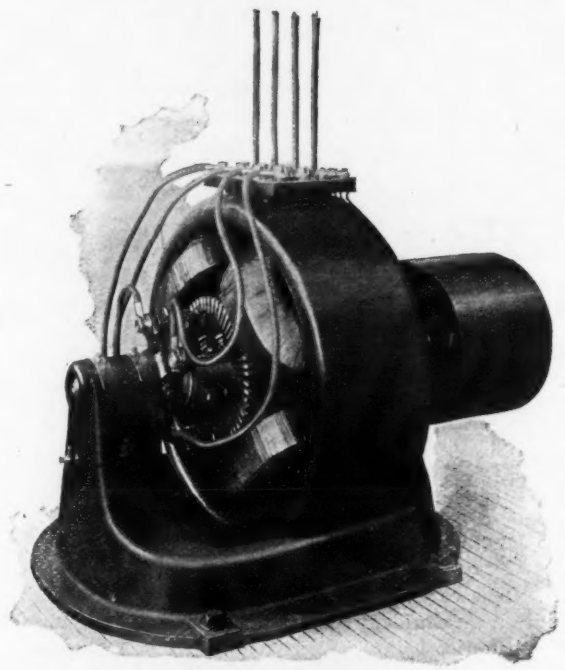


FIG. 1.—VIEW OF TWO-VOLTAGE MACHINE ON WHICH EXPERIMENTS WERE MADE.

four-path drum type. This machine has been the subject of a series of experiments with very interesting results. Of course, when the brushes are connected up in the ordinary way and the field windings joined as usual, the machine is to all intents and purposes an ordinary four-pole machine. By disconnecting the four brushes and separating the field excitation into two independent windings, each distributed over one north and its adjacent south pole, two independent machines are gained. With this arrangement, one pair of field cores may be discharged entirely, the other pair generating the full pressure of the machine, and the load on the latter may be varied from nothing to full rated load without perceptible effect on the commutation, the brushes remaining stationary. With both sides of the machine excited, either side may be run as a motor or as a generator, the load and pressure of the other side being varied under either of these conditions without interference. In this way a machine may be run as a motor generator, the motor action taking place under two poles and the generator action under the other two, the ratio of transformation being dependent solely on the relative excitation of the two field circuits.

Some of the possible interesting applications of this device are shown in the accompanying Figs. 2 and 3. In Fig. 2 the machine is shown supplying a feeder and main system, the mains being tapped off directly from one pair of brushes, the opposite pair of brushes being connected to feeders tapped into the mains at any desired distance from the machine. In this way the voltage across the first pair of brushes may be maintained at line pressure, while that across the second pair may be raised to compensate for the loss in the feeders, thus maintaining the proper potential at their junction with the

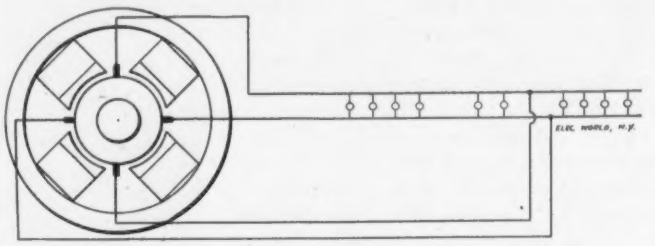


FIG. 2.—TWO VOLTAGES ON FEEDERS AND MAINS.

mains. Further, the pole between the two brushes supplying the feeder, and its complement may be so wound as to over compound for constant potential at the terminals of the feeder with changes of load, while the other two poles may be either simply shunt wound or compounded for constant potential at the brushes.

Another application shown in Fig. 3 is the use of the machine in isolated plant service to do away with the necessity for a booster on the storage battery. The machine itself accomplishes in this case what is ordinarily obtained with a compound dynamo and a differentially wound booster, whereby the battery is made to take up variations in the load, rendering the load on the engine constant. In this case the load is connected between two adjacent brushes, the poles for which may be shunt or compound wound, the other two

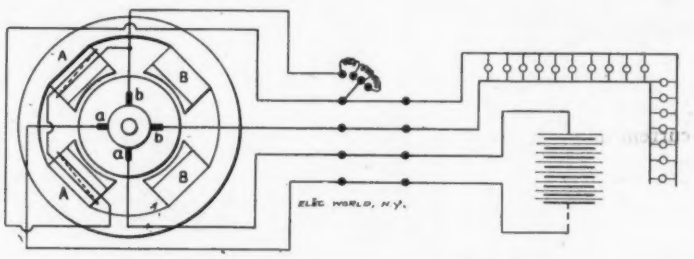


FIG. 3.—COMBINATION DYNAMO AND BOOSTER.

brushes under differentially wound poles supplying the storage battery. In this way the battery is made to help out the engine at times of heavy load and absorb its power at times of light load on the main circuit.

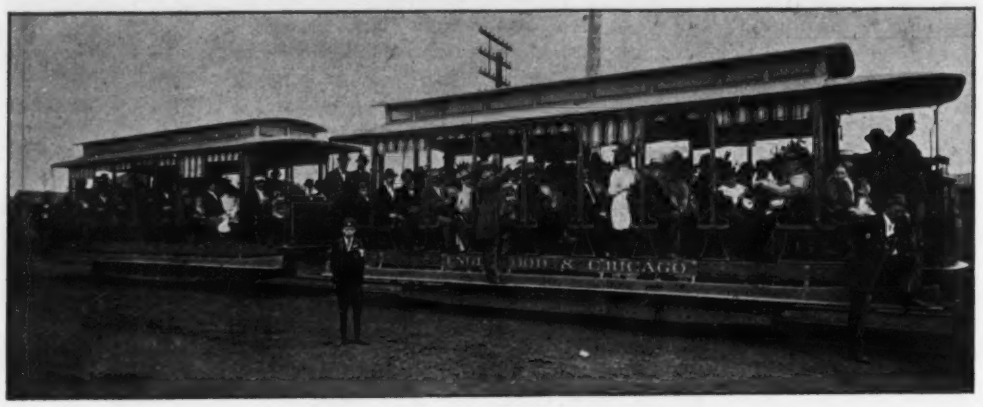
One of the most interesting possibilities of the machine is its use as a direct-current motor generator, the small machine represented having been so used to start, stop and reverse a heavily loaded motor without the use of any resistance in the main circuits. This is simply effected by running the machine as a constant potential motor, taking current in one-half of its armature with fully excited fields and supplying the motor in the other half of the armature, building up the fields from zero excitation to full field strength to build up the speed of the motor. This is the equivalent of the Leonard system of motor control, and accomplishes all that that does with its motor and generator coupled together, including the return on retardation of the power stored up in the inertia of the motor driving machinery. Strange as it may seem there is no difficulty in commutation, even with this remarkable arrangement, with brushes fixed and brief loads 50 per cent. above the rated amperes per unit cross section of copper; in spite of the fact that the distortion must be in opposite directions under adjacent pole pieces, thus bringing an intense field to bear at two points of commutation diametrically opposite; and a very weak field at the other two points of commutation. The machine, if mechanically driven, may also supply lighting circuits from one side, and motors or power circuits from the other side, or sides, if it has more than four poles. In this way, the lights are rendered much more nearly independent of the fluctuations of load on the motor circuits.

Tests of the Englewood Storage Battery Road.

The most prominent storage battery traction experiment of late years has been that on the line of the Englewood and Chicago electric railway. This line has been in operation since June 20, 1897, running from nine to twenty cars on about 12 miles of track. Complete tests of the operation, particularly of the efficiency of the various parts, have been made by Mr. G. Herbert Condict, the tests being in charge of Mr. George A. Damon, assisted by Prof. T. P. Gaylord and a corps of students from the Armour Institute. A short description of the plant will be of interest to make the tests more clear.

The power plant consists of three Heine water tube boilers of 200 rated horse-power, each fitted with Roney mechanical stokers. In the smoke flue connecting the power house and the stack is a Green economizer, fitted with shunt passages and dampers. The steel self-supporting stack is 150 feet high and 7 feet in diameter. The two engines are of the Willans central valve type, triple expansion, made by the M. C. Bullock Manufacturing Company, of Chicago. Each engine has two cranks with three single-acting pistons on each piston rod, giving 200 horse-power at 380 revolutions. They are direct coupled by means of the Arnold system to four six-pole shunt wound Walker generators, each dynamo armature being carried on a hollow quill through which extends a shaft with clutches so arranged that either engine can operate any one or more of the generators. The latter are rated at 190 kilowatts, their voltage being variable from 160 to 190 volts. Provision is left for a third engine between the two pairs of generators, the opening now being closed by a solid shaft. Worthington jet condensers are provided, with a Worthington cooling tower cooled by a blast from a motor driven fan.

A white marble switchboard, 22 feet long by 7 feet 6 inches high, carries the instruments. It is fitted with five panels, one for each dynamo and one for the controlling apparatus of the various motors.

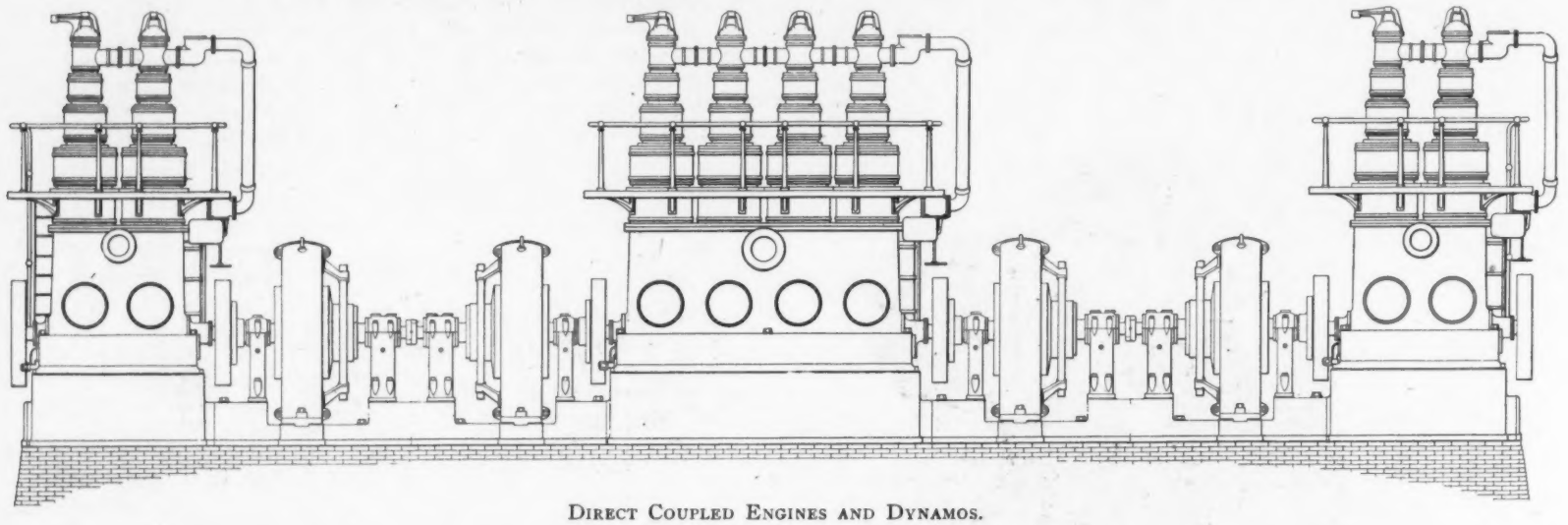


Open Motor Car and Trailer.

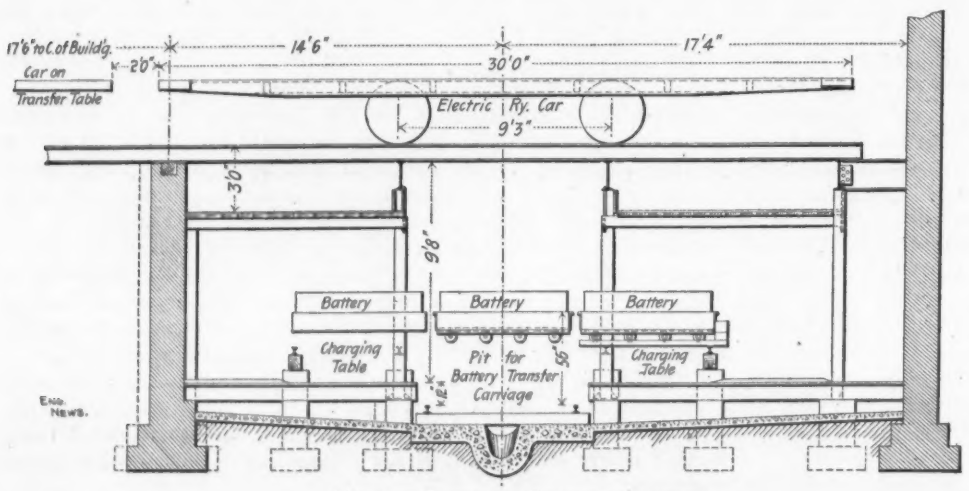
Three sets of positive bus bars are mounted for high, medium and low voltage, with one common negative bus bar.

The cars are provided with wooden battery boxes or trays with brass contacts, the whole being hung from the truck frame between the axles. This carries seventy-two cells in hard rubber jars, each fitted with five chloride negative plates and four Tudor positive plates, the batteries being connected up in four groups of eighteen cells each, the terminals of which run to the controllers. The weight of the batteries and tray is 7800 pounds, and the capacity 400 amperes at 145 volts. The trays are removed to the charging table by a motor driven derrick on a truck running in the car house pit. The batteries were built by the Electric Storage Battery Company, of Philadelphia. The car trucks have an extra long wheel base to provide room for the battery trays, each truck being equipped with one 50-hp four-pole Walker series motor, overhung on the end of the truck. The motor cars weigh complete about 12 tons and pull trail cars weighing 3 tons each. The controllers are specially designed for low resistance contacts, and are arranged for five different series parallel combinations of the batteries with and without resistance, and utilizing a shunt on the series field of the motor for highest speed.

In the first power house tests the plant was run with two boilers, two engines and three generators. The fuel was Fairmount coal, costing $1.90 per ton, and giving 10,145 B. T. U. per pound. The

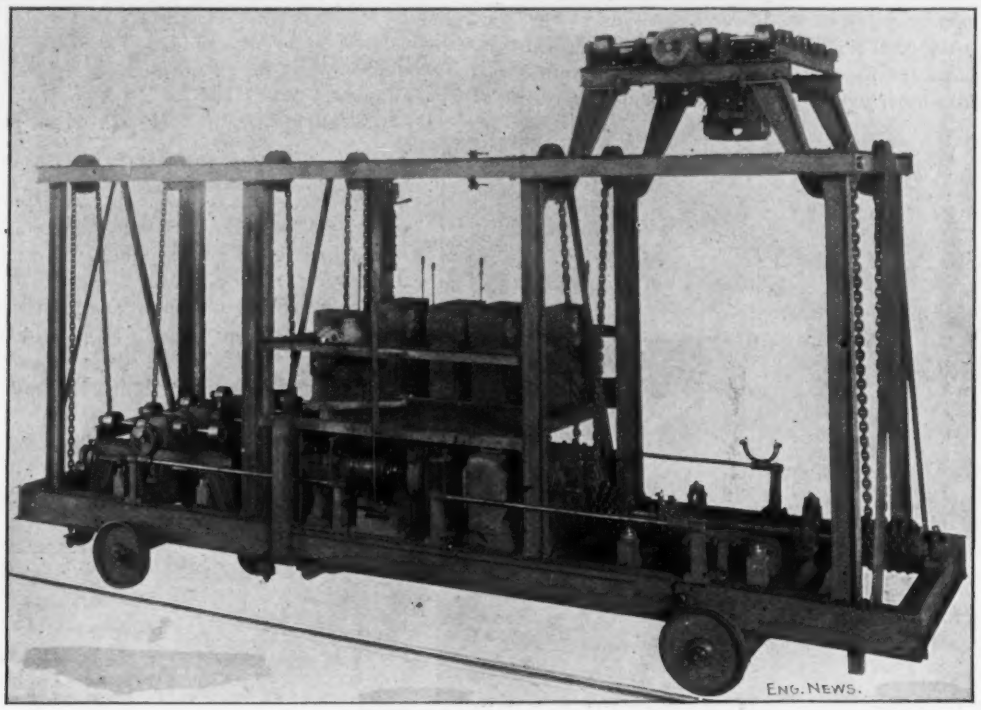


Direct Coupled Engines and Dynamos.



Pit for Battery Charging Tables.

average steam pressure by gauge was 168.3 pounds. The trial lasted nine hours, 7000 pounds of coal being burned and 43,323 pounds of water actually evaporated. The water evaporated per pound of combustible from and at 212° was 8.22 pounds, the percentage of the total calorific power of the fuel utilized being 62.86. The indicated engine power varied from a maximum of 246 to a minimum of 202, on a gauge pressure averaging 171.3 pounds and a vacuum of 24.25 inches, the pounds of dry steam per indicated horse-power hour being eighteen. The ratio of the electrical horse-power output of the dynamo to the indicated horse-power of the engines was 79.3 per cent., the watt hours per pound of coal being 155.2, making the cost of coal per net kilowatt hour at the switchboard .611 cent. The pumps used 14.36 per cent. of the water evaporated by the boilers, this being, however, not a total loss, as the pump exhaust was used for heating the feed water. With one engine operating one generator running on open circuit, a friction load of 32.26 indicated horse-power was shown. This is about 15 per cent. of the horse-power indicated in the test. The total station efficiency from coal pile to switchboard was 5.58 per cent. The high cost of fuel per kilowatt hour is largely chargeable to the high price for poor grade of coal. The tests of the batteries showed a charge of 36.757 kilowatt hours, followed by a discharge of 19.715 kilowatt hours and a second charge of 31.631, giving an apparent efficiency of a little under 60 per cent., it being difficult to obtain a more exact figure without a long series of charges and discharges, owing to the impossibility of determining the exact condition of the battery at any time. The tests showed that the car used 1.41 kilowatt hours per car mile at the charging table and .87 kilowatt hour per car mile at the motor, giving about ten pounds of coal per car mile.



BATTERY TRANSFER CARRIAGE.

Acceleration tests were also made, showing a speed of 4 miles per hour five seconds after starting, 8 miles per hour ten seconds after starting, and 15 miles per hour one minute after starting, 986 feet having been covered on a level track. Figures upon the labor cost were not obtained in this test and maintenance figures are premature at this time. The batteries have operated from 8000 to 14,000 miles and are standing the service remarkably well.

STORAGE CELLS CHARGING.

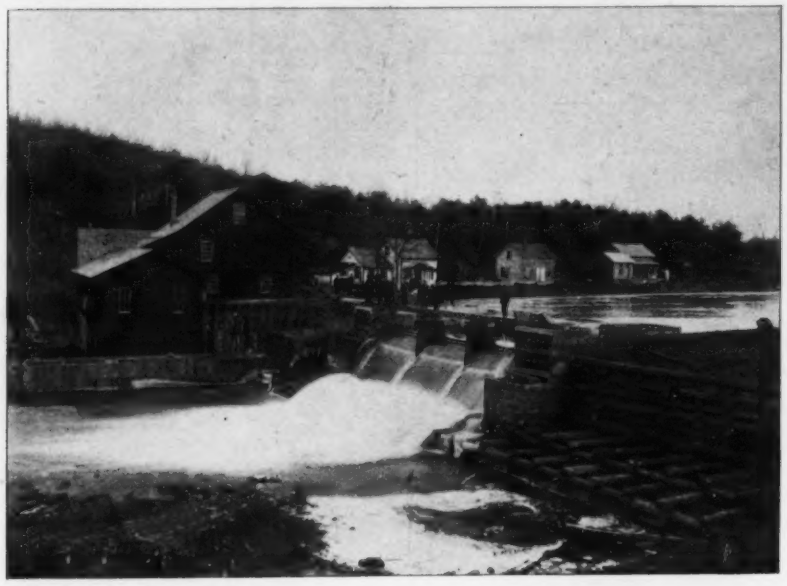
We are indebted to the *Engineering News* for the illustrations used in this article.

The Transmission Plant of the Apple River Power Company.

Although Wisconsin is often called the "Water Power State," it could never boast of any long distance power transmission plant until the past year.

The explanation is probably that water powers are so abundant throughout the State that many of the cities and towns have grown up at points where the power required was directly available.

In the northwestern part of the State there is a rapidly flowing stream of considerable size, fed by some thirty lakes and innumerable springs, that afford a nearly constant and uniform supply of water without regard to climatic conditions. For the past thirty or forty years this stream, known as Apple River, has been used for power generation at different points, but many hundreds of horse power had been allowed to run to waste. Early last spring the Apple River Power Company was organized under the laws of the State of Wisconsin, for the purpose of using a water power already developed on Apple River, at the small town of Somerset, and transmitting the energy 7 miles by means of electricity to New Richmond, a busy town in St. Croix County, Wisconsin.



General View of Dam and Buildings.

New Richmond is situated 35 miles east of St. Paul, on the lines of the Wisconsin Central and the Chicago, St. Paul, Minneapolis and Omaha Railroads. Located there are a number of mills that had been using steam plants for the power they required. The city is also electrically lighted, and the Apple River Power Company, before it began operations, obtained a contract for doing all the city lighting and pumping the city water supply, beside several contracts for power for mills, elevators, etc.

Having these to start with, and additional work in sight, the company purchased at Somerset an extensive power site, which had been used since 1856. In order to maintain a higher head than was first planned, and to have a place in which to store water, the company recently purchased 200 acres of land additional up stream and adjoining the original purchase.

The old dam was taken out and a new one built, much heavier in construction, and affording a 20 foot head. A 500 foot raceway was added, in order to secure a still greater head for the expected additional demand for power. The plans and specifications for much of the hydraulic work were made by Mr. E. H. Maskrey, and the work was carried out by Mr. Robert A. Lang, of Eau Claire, Wis. The dam is built of cribs of white pine timber, filled with quarried granite. It is provided with one 14 foot hoisting gate, and a spillway 50 feet in width.

The old feed mill has been reconstructed, and is operated by the company for the local feed grinding. Adjoining the mill has been built a commodious fireproof dynamo house, 22 feet wide by 52 feet long.

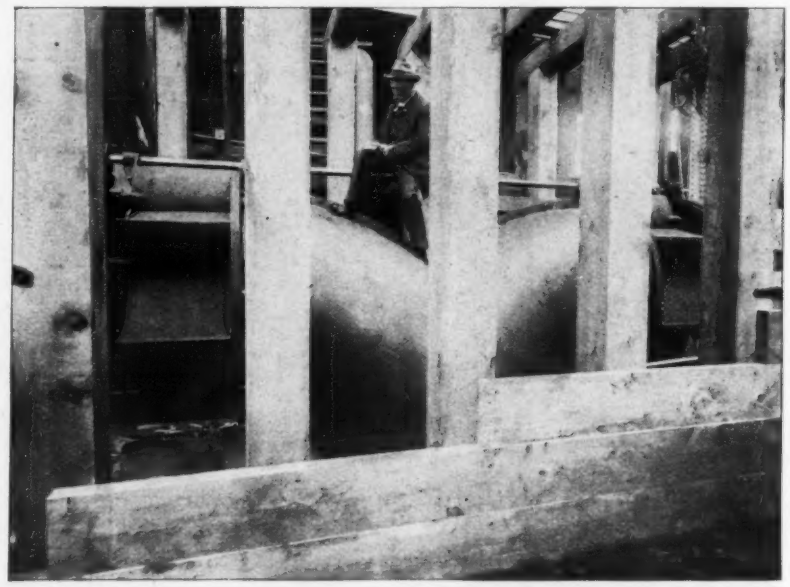
New water wheels of the most improved horizontal type have been installed. They are of the Dayton Globe Iron Works manufacture, designed to run at 130 revolutions, and each guaranteed to develop 231 horse-power on an 18-foot head, with an efficiency of 80 per cent. Both wheels are mounted on a single shaft which projects through the end of the flume and carries a 11½-foot 34-inch pulley, to which the dynamo is directly belted.

The turbines, as shown in the accompanying line drawing, are twin 42-inch machines by which the end thrust is neutralized, mounted on a horizontal 6-inch shaft, and discharging into a double quarter-turn cast-iron central draft chest fitted with a draft tube 7 feet in diameter and 8 feet long running into a wheel pit 12 feet deep. Above the wheels is a shaft by which the motion of the governor is communicated to the main chutes. The governor is that known as the Fruen water wheel governor, and acts on the mechanical relay principle. The centrifugal balls, one of which is shown at the very top of the illustration, raise or lower the double clutch, engaging either one or the other of a pair of oppositely turning bevel gears, with the shaft to which is geared the water controlling mechanism. The bevel gears are driven by bevel pinion and belt from the main shaft. A hand wheel is also fitted for manual control.

The contract for all the electric apparatus was awarded to the Westinghouse Electric and Manufacturing Company, of Pittsburg. This contract called for one 250-kw, 6000 volt, three-phase alternating current generator of the new inductor type; two 2½-hp 125-volt exciters, complete; marble switchboard, with all necessary instruments; one 100-hp, one 50-hp, one 30-hp two-phase brushless type motors; one 25-hp brush type motor; five 50-kw and two 25-kw 5500-volt three-phase to 220 volt two-phase, self-ventilating oil transformers; and six sets of 6000-volt Wurts combination choke coil non-arcing metal lightning arresters.

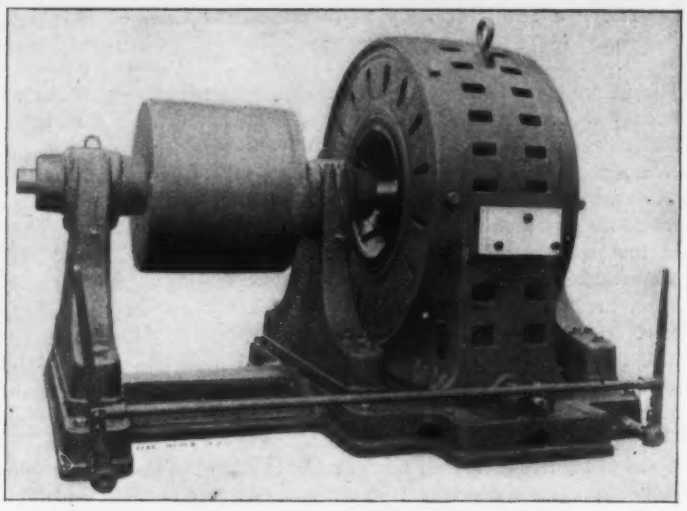
As the inductor type generator is a comparatively new departure for the Westinghouse Company, a description of this machine may be of interest.

As shown in the accompanying illustration, the general outline of the machine is the same as the others of Westinghouse manufacture. Keyed to the shaft is the inductor, a massive steel wheel, around one end of which are cast laminated steel radial projections, which serve as pole pieces. The other end of the inductor is extended in cylindrical form, and surrounded first by a stationary coil,



Turbines in Place.

through which the exciting current is sent, and second, by an extension of the stationary yoke, which is a part of the armature of the machine, and serves to complete the magnetic circuit. Dovetailed into the inner side of the annular armature yoke are the sheet steel armature laminations, properly slotted to receive the carefully wound high potential armature coils in which the 6000-volt current is generated. As there is only one set of revolving inductor poles the armature teeth are complete in a single section parallel with the

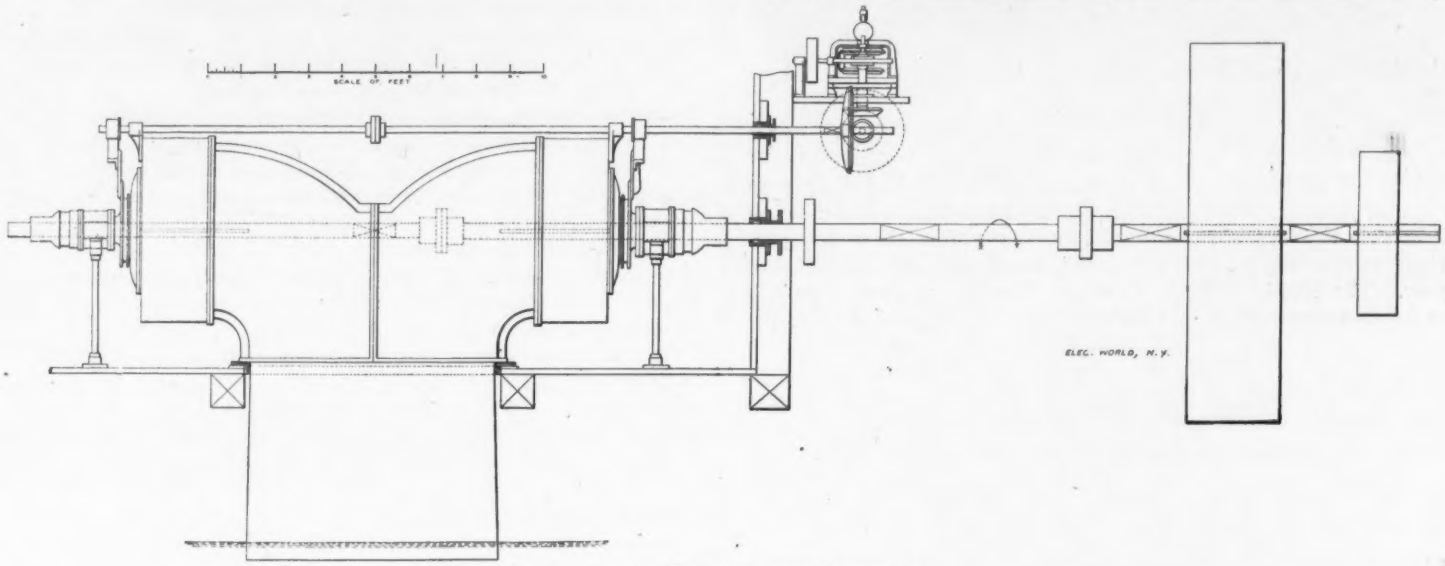


BELT DRIVEN INDUCTOR ALTERNATOR.

this form of construction it will be seen that the wires form an equilateral triangle, which is 18 inches on each side, making a handsome appearance, and reducing the inductive effects to a minimum, without crossing and recrossing wires. Between 6 and 7 tons of No. 5 hard drawn wire were used in the construction of this line. The wires are supported by No. 2 triple petticoat "Imperial" porcelain insulators furnished by the Imperial Porcelain Works, at Trenton, N. J., and guaranteed to stand 40,000 volts.

Although the full potential of transmission is generated in the dynamo, at the distributing end of the circuit, transformers are used to reduce the voltage from 5500 to 220 volts.

New Richmond has been using for a number of years the Edison three-wire 220-volt system of direct current incandescent lighting, with a separate machine and circuit for the arc lights. The A. C. transformers now installed transform the energy supplied by the pole line, not only from 5500 volts to 220 volts, but also from three-phase to two phase. The transformers are specially designed with a lead from the middle of the secondary wires. The two outside transformer terminals are connected with the old Edison 220 volt outside wires, and the extra lead from the transformers to the middle wire of the Edison system allowing the use, as before, of 110



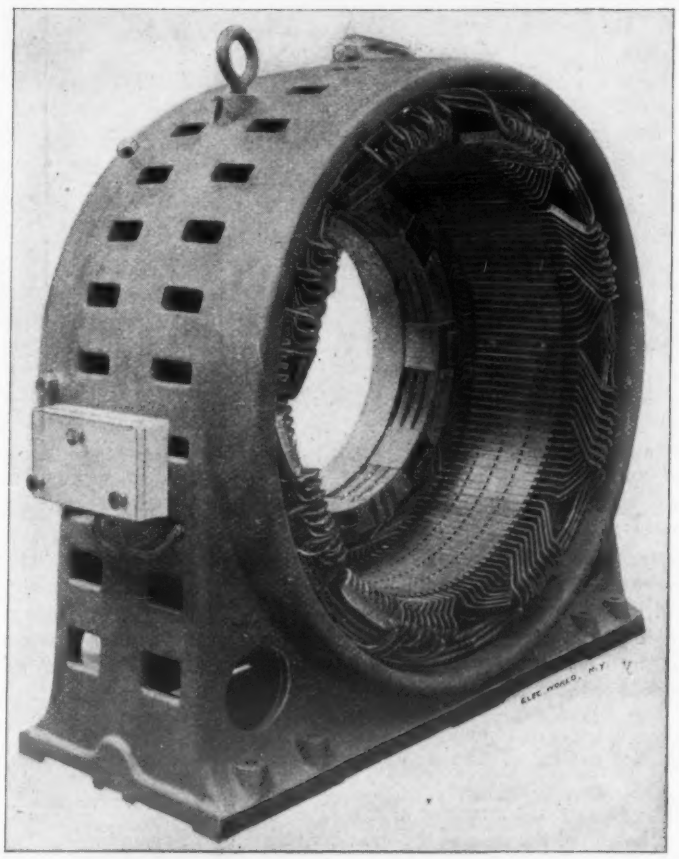
ELEVATION OF TURBINES AND GOVERNOR.

shaft, and they are surounded by single coils, giving, it is claimed, better efficiency and regulation than can be secured in types of apparatus having the armature teeth divided into two or more sections. The frequency is 60 cycles per second, the machine having 16 poles and running at a speed of 450 revolutions.

The main switchboard is a one-panel marble board provided with three 30-ampere A. C. ammeters, one A. C. voltmeter, exciter and field rheostat and two plug switches in the main field circuit. There is no main switch in the generator leads, but the machine is protected from short circuit by three 25-ampere aluminum fuses.

The generator weighs complete 23 tons, and was moved in one piece from the Westinghouse factory to the foundation on which it now stands. Owing to the lack of stability of the country roads, it required three weeks' time in which to move the machine the 4 miles between the railway station and the plant. To accomplish this journey it was mounted on a hugh truck, alone weighing 6 tons. To prevent the truck sinking to the hubs even in the hardest and dryest country roads, it had to be run on timbers, and when, on reaching the river, it was found the bridge spanning Apple River would not sustain the combined weight of the dynamo and truck, it became necessary to build a stone tramway filling in the river from either bank, except for a distance of about 20 feet in mid-stream, which was bridged by massive timbers.

The pole line which transmits the energy at 6000 volts from Somerset to New Richmond, is about 7½ miles in length. In order to keep the line as nearly straight as possible, the right of way was secured, not only from the three townships through which it runs, but also from a large number of private individuals. The poles are all of cedar, mostly 25 feet in length and 7 inches in diameter at the smaller end. Where crossing highways and in the city 45 foot poles are used. The smaller poles are all set 5 feet in the ground, and the taller poles 7 feet. Throughout two-pin cross arms, braced with galvanized iron braces and bolts are used. The tops of the poles are surmounted by Locke's galvanized ridge irons. From

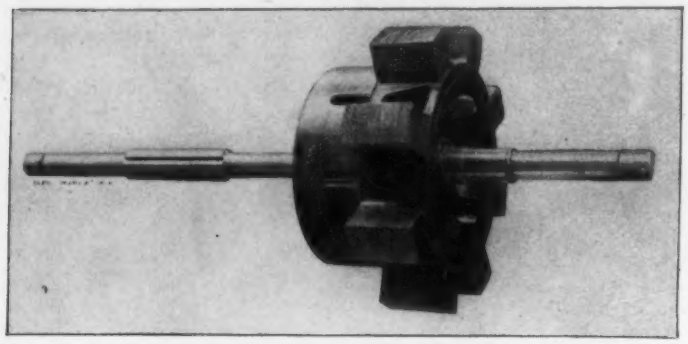


STATIONARY ARMATURE AND FIELD COILS.

volt lamps without any further change in the system that was already installed.

The thirty light T.-H. arc machine continues to supply the direct current arc lamps, the dynamo being driven by a 20-hp two-phase motor. Another two-phase motor of 30 horse-power is direct-connected to a Quimby screw pump of 750,000 gallons daily capacity, and is used for supplying the city water, which it does very efficiently and satisfactorily.

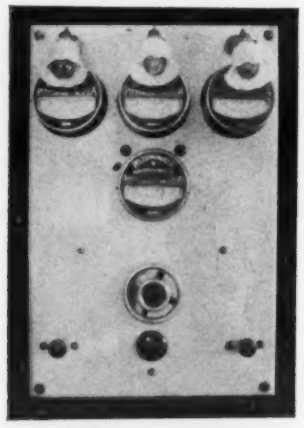
In the engine room of the New Richmond Rolling Mills Company, alongside the old steam engine, now out of service, stands a



Rotating Inductor.

100-hp brushless type two-phase motor, which is belted directly to the mill shafting. Since the starting up of this motor, the mill has been able to increase its output about 10 per cent. above any previous record, and about 30 per cent. above any output made last year. The Northern Grain Company has two motors of 50 and 15 horse-power respectively installed, the larger one belted to the main elevator shafting, and thus driving the miscellaneous machinery connected thereto. From the secondaries of the same transformers that supply the larger motor wires are run several hundred feet to a smaller motor, that is used to drive the second elevator. At each of the three points at which power is supplied, separate sets of transformers are installed, two in each place. The larger motors are built with short-circuited rotating secondaries, the starting being effected with an auto-converter giving a reduced voltage.

At each end of the transmission circuit banks of lightning arresters and choke coils are installed, which protect the apparatus connected to the circuit.



Main Switchboard.

President F. W. Epley. of the Power Company, writes: "Our generator is almost as simple as a grindstone, and runs cold with a load of three-fourths of its rated capacity. The service we have so far given our patrons is pronounced by them as absolutely perfect. * * * The whole system started up like clockwork, and has worked without a hitch ever since."

Next Meeting of the American Street Railway Association.

The executive committee of the American Street Railway Association has fixed the date of the next convention on September 6, 7 and 8, the place to be Boston, Mass.

The Present Efficiency of Incandescent Lamps—II.*

BY JOHN E. RANDALL.

The filament is the most important element of the lamp, so far as efficiency is concerned. Filaments are now made from a form of cellulose, reduced chemically to an amorphous state.

Not many years ago, when the bamboo carbon was supreme, we had occasion to complain about the poor quality of a certain lot of bamboo strips which we had received from an importing firm. They said that they could not guarantee a natural product. This furnished the key to the success of the cellulose filament. Art replaces nature, breaking down the structures of a fibre, reducing it to a plastic condition, then spinning a thread radically different in appearance and character from the original material. Instead of whittling down a stock to make a lamp filament, we now cause the filament to grow.

The quality of the filament is determined by the thread. The process of squirting threads is controllable if proper skill, experience and appliances are employed. Yet the weather is more controllable than is the quality of the product when any of these requisites is lacking. It is easier to shave down strips of bamboo to a uniform size, or to weave braids of silk fibres that will appear to be even than it is to squirt a cellulose thread of uniform diameter, but the bamboo strips and the silk braid will not be uniform in weight. They cannot, therefore, make uniform carbons.

It may be supposed that the coating of carbon applied in treating the filaments fills up the pores and depressions, thereby correcting the defects due to irregularities in texture and surface. This is not true. A poor base carbon cannot make a good lamp. When one filament is found to be better than another, its superiority can be attributed to the base carbon.

In purity, density, surface polish and uniformity, the features that determine quality and maintain efficiency, the cellulose filament, properly made, far excels any other kind.

A graphitic coating covering an amorphous carbon body in a vacuum is, so far as is known, the best combination for fulfilling these conditions. The science of lamp making consists in knowing how the carbon body can be formed, how the graphitic coating can be given and how the vacuum can be produced. The art of lamp making consists in doing these things perfectly and uniformly a thousand times over every day.

Whenever lamps are found to be uniform in voltage and efficiency they are found to be good.

In all their minor features recently made lamps are superior to those of older dates. They are uniform in shape and neater in general appearance. The caps are securely attached, and more durable in every way. They are entirely fireproof and nearly moisture proof. The bulbs are clearer, cleaner and alike in shape and size. The carbons are placed in the bulbs so as to be more effective and more symmetrical. The connections, both within and without the bulbs, are more secure. Cracks and poor vacuum have about disappeared.

These features help the service that can be derived from the lamps. They form part of the general economy of operation, and therefore influence the efficiency.

Another point worthy of consideration is the evolution of types suitable for the different conditions of service; one for closely regulated central stations, one for poorer regulation and isolated plants in general, one for street railways and other purposes in which, for certain reasons, the service is severe. Added to these are the almost innumerable varieties for special uses, such as window decorations and signs. Finally the use of cellulose has made the 220-volt lamp a commercial possibility.

It may be claimed that the new lamps are more delicate than the older bamboo, in that they cannot be run as long before the filament will break.

The principle upon which all practical methods of illumination is founded, that of incandescence—excessive activity—limits the period of effective service and induces early destruction. We may as well accept the condition of limited life, in the case of the incandescent lamp, knowing that no other light is better in this respect if all factors are considered.

I am not willing to admit that the cellulose filament is more delicate, either in transit or in service. Under identical conditions it will live longer than any other form of filament. Furthermore, the individual life approaches nearer the average than has been the case

* Paper read before the Northwestern Electrical Association, January, 1898.

with any other material. Any carbon filament which will not maintain its brilliancy should be expected to live to a good old age.

The life of cellulose lamps at three watts per candle-power should not be compared with bamboo or silk at four. The 4-watt cellulose railway lamps are giving more satisfactory service than those of other materials. Their light is more uniform and they last longer.

Recent lamps are approaching the ideal one which, when its work is done, breaks and thus announces its own "smashing point."

The best proofs of any claims are those based upon actual performance. In support of the claim that the present efficiency of incandescent lamps is more satisfactory than the past, I submit some comparisons.

In the subjoined table are results of tests made upon three clases of lamps: First, the 110-volt cellulose; second, the 110-volt untreated bamboo; third, the 50-volt treated bamboo. The initial watts per candle-power were nearly 3.2 for all. The bamboo lamps represent their class, both the 110-volt and the 50-volt having been carefully selected. The tests upon these were a part of a series upon a large number started in groups of various initial watts per candle, and their results are consistent with those of the entire test. The tests were carefully conducted with the best facilities. They may be considered reliable. Both lamps were at one time extensively used and well regulated.

The figures shown for the cellulose lamps are the combined results of a number of tests made at various times and places and by different persons, but evidently made under similar conditions so far as regulation is concerned. There is excellent agreement, not only in averages, but in individual cases, both in candle-power and in watts per candle-power. The oldest tests which were made over three years ago, show the poorest results. This fact suggests a gradual improvement in the quality of the cellulose lamp. All the lamps entering the tests were samples of commercial lamps taken at random from large lots. No claim is made that the results are remarkable. I believe that they can be relied upon to represent faithfully the present efficiency of the incandescent lamps supplied for central station use.

AVERAGE CP. AND W. PER CP. OF BAMBOO AND CELLULOSE LAMPS DURING VARIOUS LENGTHS OF BURNING.

During a run of..		0 Hrs.	100 Hrs.	200 Hrs.	300 Hrs.	400 Hrs.	500 Hrs.	600 Hrs.	700 Hrs.
Average cp.	Cellulose, volts—110..	16.	15.80	15.86	15.68	15.41	15.17	14.96	14.74
	Bamboo, volts—110..	16.	14.1	12.9	11.8	11.0	10.4	9.9	9.6
	Bamboo, volts—50...	16.	15.8	15.3	15.0	14.6	14.2	14.0	13 7
Av. w. per cp.	Cellulose, volts—110..	3.16	3.26	3.13	3.37	3.53	3.51	3.54	3.74
	Bamboo, volts—110..	3.20	3.50	3.80	4.08	4.32	4.53	4.75	4.90
	Bamboo, volts—50...	3.20	3.28	3.37	3.45	3.53	3.61	3.67	3.76

The remarkable feature is the close agreement between various lots made at widely different times. This feature is the criterion of quality. Upon it depends the successful introduction and use of the highly efficient lamp. I believe that the results given can be relied upon to represent faithfully the present efficiency of the incandescent lamps supplied for central station use, because every result was used in the table, whether good, poor or indifferent.

This table shows the mean candle-power during a certain period of service, and not the value found at the end of the period. For example, if a cellulose lamp, whose candle-power is 16 at the start and whose economy is 3.2 watts per candle-power, is in service for 500 hours, it will average 15.17 candle-power during that period, but will give less than that value at the end. If a 50-volt bamboo lamp of the same brilliancy and economy is used for the same length of time, its candle-power will average 14.2. The 110-volt bamboo will, under the same conditions, average only 10.4 candle-power. In the latter case, especially, the great change in the brilliancy of the lamps after they had been running for a short time would be very noticeable.

Viewed in another way, if a station furnishes a service of fifty cellulose lamps to one customer, and to his neighbor a similar number of 110-volt bamboo, charging the same for each service, the one would be justified in demanding that his lamps be removed every 100 hours, in order to keep his place as bright as his neighbor's.

A 50-volt bamboo lamp, to maintain the same average brilliancy as the 3.2 cells cellulose during any period from 500 to 700 hours service should have an initial efficiency of 3.4 watts per candle-power. A 4-watt 110-volt bamboo would not maintain its brilliancy as well as a 3.2 watt cellulose.

While one of the lamps involved in the tests failed before 600 hours, no other conclusion has been drawn from the facts than that the percentage of early failures of lamps, operated under good condition, is so small as to be neglected.

Lamps are to-day more uniform in wattage. A variation in current of 2 per cent., either way from the average, is rare. Candle-power is tested while the lamp is revolving. Thus, the true horizontal value is determined. The value of light standards is carefully guarded and constantly checked. The accuracy of all instruments employed in the photometer room is kept at the highest degree. While an official standard of candle-power does not exist, this fact has not caused the great divergence in the light value of different lamps. The most prominent manufacturers are in agreement as to the value of the 16-cp lamp. Their standards check more closely than do those of the technical schools. Lamps vary in candle-power because of carelessness and sometimes deception in rating. In the Columbia factory accuracy of rating is considered a matter of prime importance, and constant effort is made to keep the standards exact. Each lamp has a mark whereby its history may be known. The volts at which it gives its normal revolving horizontal candle-power, together with the current passing, are marked upon a suitable label. A record of these items for each lamp is made at the same time upon a sheet. These sheets are the indices of uniformity in the product.

One of the largest alternating stations in the country has, by substituting the highly efficient cellulose lamp for the low economy silk and bamboo, and by improving its regulation, been able not only to reduce the price of service to its customers but to increase its lamp capacity over 25 per cent.

There is still one condition to be fulfilled in order that incandescent lighting may be more profitable—the voltage *at the lamps* must be kept everlastingly and unceasingly steady. There has been improvement, but much more is possible and desirable. Everything about lighting service is improved where regulation is improved, even the customer's temper.

Regarding the "Keying" of Advertisements.

Mr. Campbell Scott, who has charge of the advertising of the C & C Electric Company, of this city, "keyed" his advertisements in the different electrical journals for a period of three months, to ascertain the relative returns received from them. He found that the returns from THE ELECTRICAL WORLD were about three times greater than from any other journal, and about as great as from all the others combined. Mr. Scott very kindly addressed to THE ELECTRICAL WORLD a letter to this effect, which THE ELECTRICAL WORLD naturally published for the benefit of other advertisers.

Accompanying the letter it published a list of the advertising which the C & C Electric Company had done during the entire year 1897, so that those interested might have all the information before them.

The other electrical journals appeared to feel very much chagrined over the whole matter, and are endeavoring to give the impression that Mr. Scott does not know what he is talking about, and that the action of THE ELECTRICAL WORLD in publishing the letter was reprehensible, and does not show the fraternal spirit that they think ought to exist among journals in the same line of business.

Neither THE ELECTRICAL WORLD nor its advertisers would have attached any extraordinary importance to Mr. Scott's letter had not the other papers drawn so much attention to it. Many others during the last quarter of a century have made similar tests, and always with the same result, so that Mr. Scott's tests are only in line with all the others.

There was, of course, no understanding or collusion of any kind between Mr. Scott and THE ELECTRICAL WORLD. Mr. Scott says his only object was to get information, and that he would just as willingly have given the letter to any other paper had the result of the test been different.

Electricity Direct from Fuel—II.

BY C. J. REED.

Having devoted to the earlier experiments and claims of Dr. Borchers all the attention they seem to deserve, we may now consider the merits of the galvanic batteries recently described by him, in which also he claims to have obtained electrical energy from the oxidation of carbon monoxide.

We note at the outset that he now abandons his claims of directness in the oxidation, using as oxidizing agents not oxygen or even a copper salt, but the more familiar depolarizers, lead peroxide,

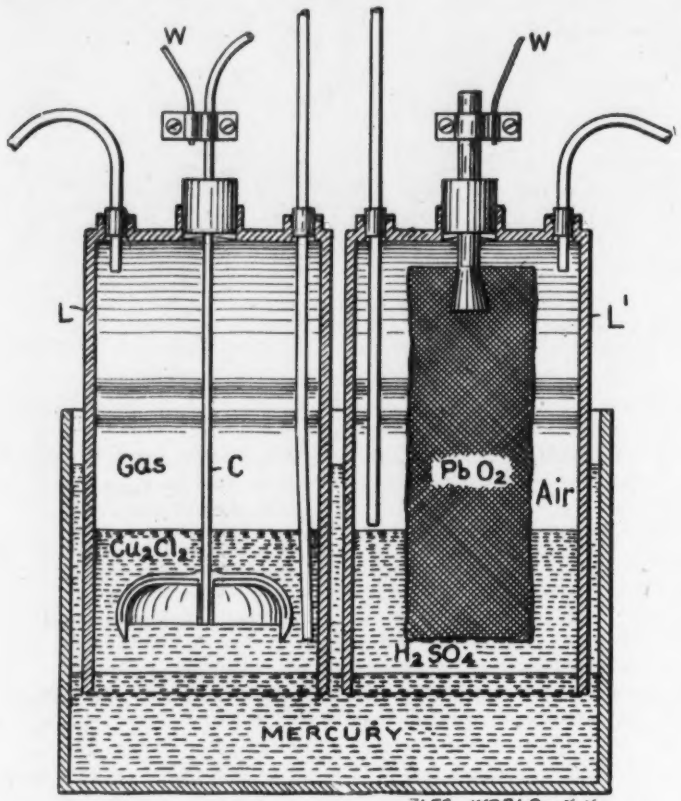


FIG. 2.

PbO_2, and manganese dioxide, MnO_2. He employs oxygen only to regenerate and reoxidize the manganese by the well-known Weldon process, which he now distinguishes as a process of "ionization of atmospheric oxygen."

These batteries are of the two-fluid type, in which a porous partition separates two electrolytes, each containing an electrode. One experimental battery he describes consisted of two galvanic cells of different kinds connected together in series through a common electrode of mercury, the arrangement resembling a Kellner-Castner electrolytic cell. It is illustrated in Fig. 2, in which *L* and *L'* represent two glass bell jars, each being open at the bottom and provided at the top with three perforations, one for a conductor or electrode and two for glass tubes. These bell jars are placed mouth downward in a vessel containing mercury, the upper surface of which is at *H*, so that the mouths of the jars are below the surface of the mercury. The jar, *L*, is partly filled with a solution of cuprous chloride, into which projects the "metallic" tube, *C*, and the bell-shaped gas-distributing electrode shown at the lower end. The bell jar, *L'*, contains an electrode of lead peroxide or manganese dioxide, connected with the conducting wire, *W'*, and a solution of dilute sulphuric acid. Into this jar were introduced air or other oxidizing gases, and into *L*, the carbon monoxide or other reducing gases. The mercury formed the negative electrode of the cell, *L'*, and the positive electrode of the cell, *L*. Of what metal the tube, *C*, and the electrode at the bottom of it were constructed, Dr. Borchers neglected to state. A modified form of this battery, containing manganese dioxide and dilute sulphuric acid in one cell and an acid solution of cuprous chloride in the other, gave an E. M. F. of about 0.5 volt when carbon monoxide was used. What E. M. F. was obtained without the carbon monoxide he does not state.

He finally abandoned as worthless all forms of the battery except the one shown in Fig. 3. It is the only one of which he gives any definite data. It consists of an iron or lead cell, *K*, containing "Weldon mud" (manganese dioxide and lime), *E*², a porous cup *D*, containing a solution of cuprous chloride E', and a carbon electrode, *A*. *T* represents a tube, through which illuminating gas is passed into the cuprous chloride, the excess escaping through *T'*. T" is a tube, through which air is blown into the Weldon mud. He does not state any of the dimensions of the cell or electrodes, the E. M. F. on open circuit, nor the means by which his measurements were made, but gives his observations of current and potential difference in Table IV. From the table we see that he obtained a maximum potential of 0.61 volt, a maximum current of 0.42 ampere and a maximum output of 0.076 watt. The cuprous chloride solution was composed of

80	grams	cuprous chloride
100	"	ammonic "
50	"	sulphuric acid
500	"	water

TABLE IV. (Cu_2Cl_2.)

External Resistance. Ohms.	Potential Difference. Volts.	Current. Amperes.
100	0.610	0.0100
90	0.600	0.0100
80	0.600	0.0100
70	0.600	0.0100
60	0.600	0.0100
50	0.600	0.0150
40	0.590	0.0175
30	0.580	0.0200
20	0.580	0.0300
10	0.550	0.0600
5	0.500	0.1000
2.5	0.400	0.1900
1	0.225	0.3400
0.5	0.070	0.4200

He next substituted for cuprous chloride, successsively, stannous chloride, $SnCl_2$; manganous chloride, $MnCl_2$; manganous sulphate, $MnSO_4$, and ferrous sulphate, $FeSO_4$. These are reducing agents that do not dissolve carbon monoxide. The results are given in Tables V., VI., VII. and VIII.:

TABLE V. ($SnCl_2$.)

External Resistance. Ohms.	Potential Difference. Volts.	Current. Amperes.
100	0.400	
50	0.380	0.0100
25	0.365	0.0175
20	0.350	0.0200
10	0.320	0.0350
5	0.280	0.0600
2.5	0.180	0.0900
0.5	0.017	0.1700

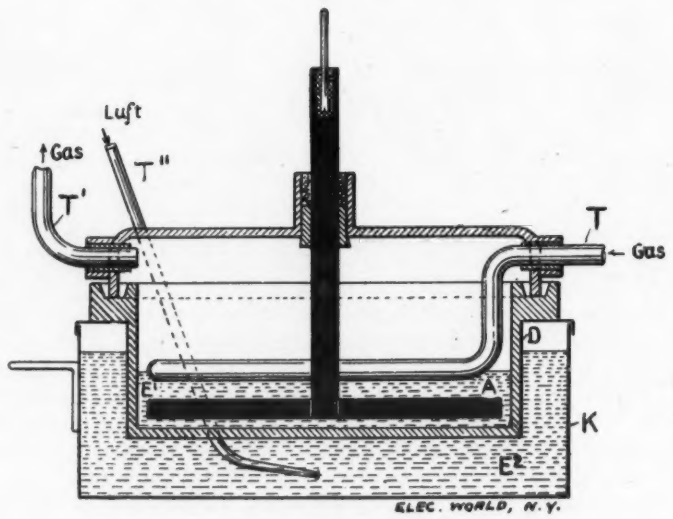


FIG. 3.

TABLE VI. ($MnCl_2$.)

External Resistance. Ohms.	Potential Difference. Volts.	Current. Amperes.
100	0.175	
50	0.170	
30	0.160	
20	0.150	0.020
10	0.125	0.025
5	0.110	0.030
2.5	0.080	0.040
0.5	0.010	0.100

TABLE VII. ($MnSO_4$.)

External Resistance. Ohms.	Potential Difference. Volts.	Current. Amperes.
100	0.260	0.010
50	0.250	0.012
30	0.240	0.015
20	0.230	0.020
10	0.200	0.030
5	0.170	0.040
2.5	0.090	0.050
0.5	0.008	0.080

TABLE VIII. ($FeSO_4$.)

External Resistance. Ohms.	Potential Difference. Volts.	Current. Amperes.
100	0.080	
50	0.075	
25	0.070	
20	0.070	Very Weak.
10	0.050	
5	0.035	

The fact that the other solutions gave a lower E. M. F. than the cuprous chloride was thought by Dr. Borchers to be a proof that the energy resulted from the oxidation of carbon monoxide, whereas it showed only that the chemical reaction with cuprous chloride evolved more energy than the reactions of the other solutions. Here again the simple experiment of comparing the results obtained with and without the gases would have shown him his error.

In all of Dr. Borchers' experiments he neglected to observe, or at least to mention, which electrode of his battery was positive and which was negative. He probably thought it too trivial a matter to waste time on, but his neglect in this matter has caused an important fact to remain concealed from the public. In his battery of 1894 the carbon monoxide electrode was negative, while in his 1897 battery it is positive. In this connection it will be instructive to remember also that in the 1894 battery the carbon-monoxide electrode was a piece of copper, the other electrode being carbon; while in the 1897 battery the carbon-monoxide electrode was a piece of carbon, the other electrode being a piece of iron or lead. How the same body can by oxidation give an electric current in one direction in 1894 and in the other in 1897, Dr. Borchers may explain in his next paper.

In order to verify, if possible, the statements of Dr. Borchers and to determine the extent and nature of the effects produced by the air and gases, I prepared the apparatus shown in Fig. 4.

The cell is a hard rubber jar 6 inches long, 6 inches deep, and 2 inches wide, containing a mixture of water, lime and manganese dioxide. In this mixture are immersed a carbon electrode, *B*, a platinum electrode, *D*, and a porous cup, 5 inches long, 1 inch wide and 6 inches deep. Inside of the porous cup is the solution of cuprous chloride, a carbon electrode, *A*, and a platinum electrode, *C*. The cuprous chloride was prepared according to the directions given by Dr. Borchers, as stated above. Electrodes, *A* and *B*, are carbon plates three eighths inch thick, 1¾ inches wide and 8 inches long. *D* and *C* are sheets of platinum one-half-inch wide and 2½ inches long, with platinum conducting wires. Dr. Borchers gave no specific proportions for the Weldon mixture and it was prepared by mixing into an emulsion with water one part of anhydrous calcium oxide and ten parts manganese dioxide. A thermometer was placed inside and another outside of the porous cup.

As Dr. Borchers made no measurements on open circuits to determine the real E. M. F., it was thought unnecessary to do so in this case, and therefore a Weston voltmeter having a resistance of 400 ohms was employed. No measurements were made with any other resistance in circuit except the voltmeter.

The potential difference between the various electrodes was first measured before any gases were introduced, the temperature of both solutions being 19° C. The readings in Table IX. were taken, the minus sign indicating the polarity of the zinc plate, and the plus sign the polarity of the copper plate of the Daniell cell:

TABLE IX.

+	volts	−
A	0.16	D
A	0.23	B
C	0.20	D
C	0.22	B
A	0.002	C
B	0.04	D

TABLE X.

+	volts	−
A	0.12	D
A	0.23—0.21	B
C	0.08	D
C	0.23—0.21	B
A	0.00	C
D	0.00	B

Immediately after taking these readings and without making any change whatever in the apparatus, a rapid current of coal gas was introduced through a glass tube into the cuprous chloride solution contained in the porous cup and was continued for about ten minutes, sufficient to thoroughly saturate the solution and expel all air. At the same time a current of air was forced rapidly through a glass tube into the Weldon mud. *A* and *D* were frequently connected during this time to the voltmeter. During the first five minutes the potential difference between *A* and *D* gradually increased from 0.23 to 0.235, while the temperature of the cuprous chloride solution increased from 19° to 19.4°. During the next five minutes the potential difference gradually fell to 0.21. Care was taken not to allow the gas and air currents to strike directly against the platinum electrodes, to avoid the absorption effect of platinum. After the solutions were thoroughly saturated and while the gases were still flowing, the observations in Table X. were made.

The slight increase in temperature of the cuprous chloride during the passage of the gas was probably due, either entirely or partly, to the absorption of the carbon monoxide by the cuprous chloride solution. It might have been greater had no heat been carried away by the current of gas passing through the liquid. It is also possible that this increase in temperature was due largely, if not chiefly, to the temperature of the gas being a little greater than that of the air. No measurements were made to determine the temperature of the air and gas used. The gas was taken from a gas jet connected to the city gas-mains and there is no reason to suppose that its temperature was any greater than that of the air, though the temperature of the cuprous chloride solution was not observed to decrease again during the experiment.

Whatever may have been the cause of this change of temperature, the fact that it occurred simultaneously with the slight increase in

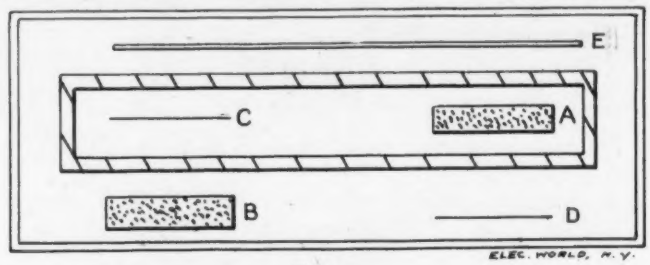


FIG. 4.

E. M. F., which amounted only to a fluctuation of 0.005 volt, is very significant, and is alone sufficient to explain this slight increase. It is evident from the measurements given above that the only permanent effect of the gases was to reduce the difference of potential from 0.23 to 0.21 volt. Whether this decrease produced by the gases was due to the oxidation of carbon monoxide, or merely to its absorption and the consequent change in chemical composition of one of the electrolytes, still remains to be determined. It is further evident from the polarity of the electrodes that the current is in the opposite direction from that which would be produced if an oxidizable substance, such as zinc or copper, were substituted for the carbon-monoxide electrode.

It will be observed that the highest potential difference obtained in these experiments, viz., that obtained from the two carbon electrodes, was much less than that obtained by Borchers, whose electrodes were carbon and iron. It was thought probable, therefore, that the difference might be due to the fact that Dr. Borchers used an iron electrode (the containing vessel) in contact with the Weldon mud. A second experiment was therefore performed, using the same apparatus with the addition of another electrode, *E*, in the Weldon mud, consisting of a sheet of iron 4 inches wide and 8 inches high. In this experiment, which was performed several days later, the following readings were made:

TABLE XI.

Without Air and Gas.			With Air and Gas.		
+	volts	−	+	volts	−
A	0.01	D	A	0.01	D
A	0.26	B	A	0.24	B
A	0.44	E	A	0.45	E
C	0.01	D	C	0.01	D
C	0.26	B	C	0.24	B
C	0.60	E	C	0.51	E

These figures show conclusively that, contrary to the statement of Dr. Borchers, the result depends very greatly upon the nature of the electrodes, and very little, if any, upon the gases introduced. There is certainly nothing in any of these results to warrant the inference that any electrical energy was derived from the oxidation of either carbon monoxide or other fuel gases.

Errata: In the first instalment of this paper, page 127, the second equation (1) should be (3), and the second (2) should be (4) and should read

$$Cu_2Cl_2+CO+4NH_3+2H_2O=2Cu+2NH_4Cl+(NH_4)_2CO_3$$

Alternating-Current Machinery—XXIV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

ALTERNATOR ARMATURES.

200. Considering the different structural forms of alternator armatures the pole armature is one of the simplest. In this the core is provided with laminated radial projections, formed by the assemblage of a number of suitably shaped punched sheets, clamped together between end plates, and firmly secured to the shaft as shown

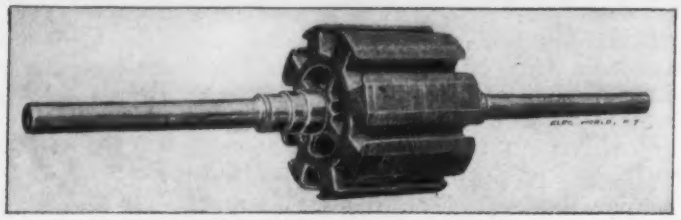


Fig. 137.—Armature Core.

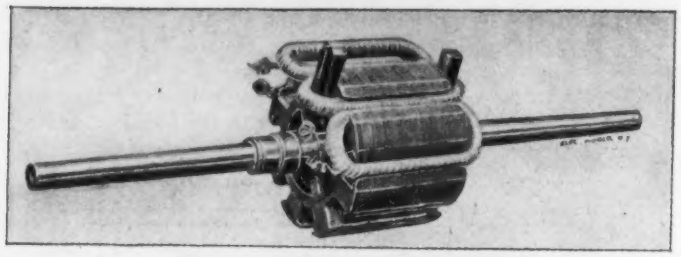


Fig. 138.—Armature Core. Method of Placing Coils.

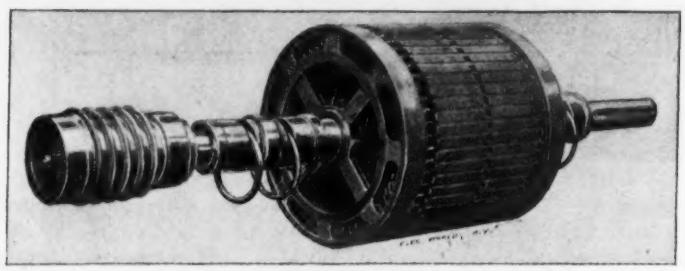


Fig. 139.—Armature of 75-kw Generator.

in Fig. 137, where a pole armature, having eight polar projections, is seen in skeleton form. The polar projections are cut away, or depressed, at the edges, in order more nearly to attain the desired type of E. M. F. wave. Each polar projection is surrounded by a closely fitting armature coil, secured in place by wedges, as indicated in Fig. 138. Such an armature is intended for use in an octopolar field, so that the magnetic flux passing through each armature coil is reversed eight times in succession during each revolution. The frequency, when expressed in alternations per minute, will therefore be equal to the product of the number of polar projections and the number of revolutions per minute. Thus, assuming that the armature makes 900 revolutions per minute, the frequency of alternation would be 7200 alternations per minute, or 60 ~ per second. The armature coils may be connected in single series, in which case the two ends of the winding are brought out side by side to two collector rings, or they may be connected up in two parallel-connected series, so as to develop their points of maximum E. M. F. at opposite ends of the armature diameter.

201. The advantage of pole armatures lies in their simplicity of construction and ease of repair. They are, however, unsuited to long-distance transmission, owing to the irregular type of wave of E. M. F. which they usually produce. Their armatures also usually possess a very marked reactance, whereby the reactive drop of pressure at full load is considerable. Another winding, commonly called a *distributed winding*, is frequently used, employing a number

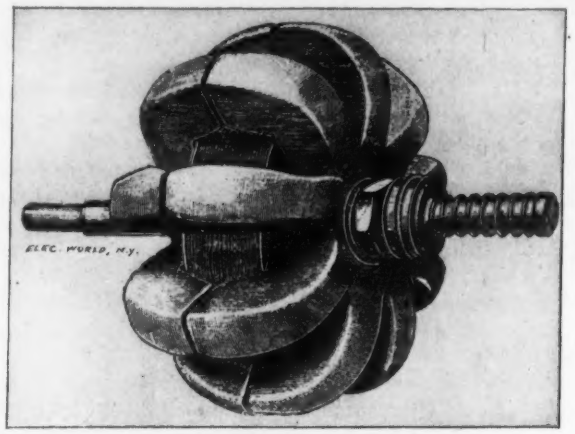


Fig. 141.—Field Magnet of Mordey Machine.

of slots in the surface of the armature, thereby increasing the number of polar projections, until these take the form of mere teeth, instead of poles. An armature thus constructed is shown in Fig. 139. In cases where the field magnets are revolved, the armature is supported in a suitable frame. A radial stationary armature of the Mordey type is shown in Fig. 140. Here the coils of wire are wrapped over insulating forms, and held in place in a surrounding frame. This type of machine is, however, very rarely found in the United States. The field magnet of this armature consists of one central core, and carries half as many polar projections at each end as there are armature coils. The polar projections are carried over and above each other, so as to leave a narrow slot between

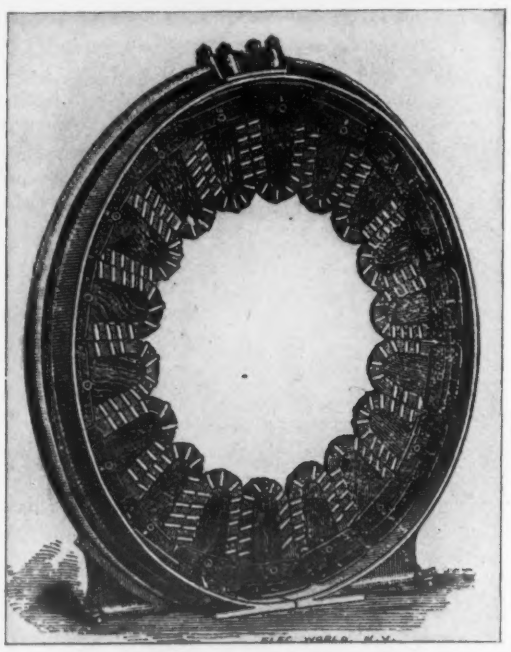


Fig. 140.

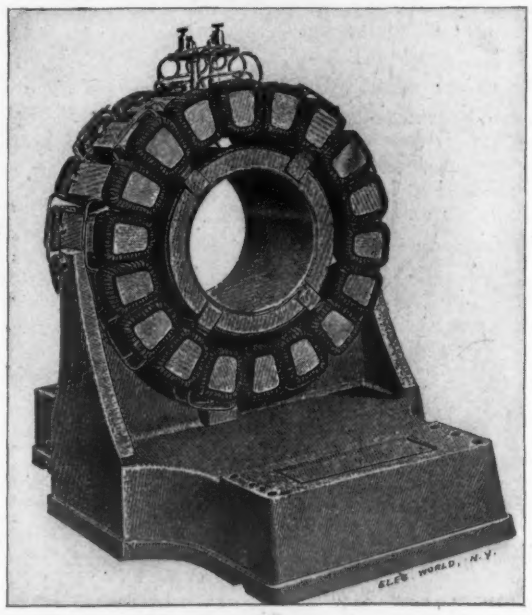


Fig. 142.—"Royal" Alternator.

them, as shown in Fig. 141. The single field coil in this machine is supported upon the core of the revolving magnet, and turns with it.

202. Another form of stationary armature is shown in Fig. 142. Here the coils are wound on the polar extremities of a series of laminated bars supported in the external frame, within which is placed the stationary magnetizing coil. Through the centre of this magnetizing coil passes the core of the revolving field magnets. Since no conducting wire is revolved in this machine, it belongs to the inductor type. The completed machine is shown in Fig. 143. The large terminals at the top of the machine are the armature terminals, and the smaller terminals between them the field terminals.

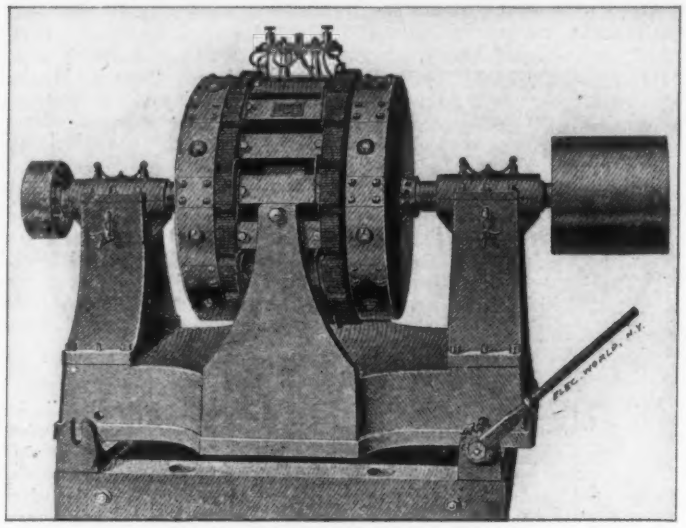


FIG. 143.—"ROYAL" ALTERNATOR.

There are half as many polar projections on the inductor as there are armature coils. In this machine, like the Mordey machine of Figs. 140 and 141, and the S. K. C. machine of Fig. 136, all the poles at one end of the field are north poles, and all the poles at the other end are south poles.

203. The advantage of inductor alternators lies in the fact that the revolving part is devoid of all brushes, wire or commutator, so that the bearings only require to be kept lubricated in order that the machine may operate satisfactorily. Moreover, the insulation of the armature coils can be better ensured and maintained when the structure on which they are carried is a rigid one. In this way the pressures, which can be generated in inductor or stationary armatures, are sometimes as high as 10,000 volts, whereas, in revolving armatures, the generated pressures are rarely over 5000 volts.

The Evolution of the Rail Bond.

To the Editor of The Electrical World:

SIR:—In your issues of January 1 and 8, Mr. Harold P. Brown, in his article on "The Evolution of the Rail Bond," attaches great importance to the plastic bond. I have made the subject of rail bonds a special study, my investigations of this subject leading me to the same conclusion as that mentioned by Mr. Brown, that is, the necessity of a low resistance contact at the joints.

The company with which I am connected recently sent its superintendent to report upon the application of the plastic bond to electric roads. The report showed that two men, whose collective wages were $3.25 per day, put in seven joints in a day's time.

In the testing of bonds too little attention is paid to the actual conditions at the time of the test. If a millivoltmeter is used to test the drop across joint after joint under actual service conditions, the return current varies so between tests that it is impossible to make any comparative results. In building an electric railroad, thousands of dollars are spent for power plant, feeders, etc., and too little attention is paid to the return circuit, an increased investment in which would reduce the necessary size of the feeders and power plant, because of the greatly reduced drop. In the case of a given plant the reduced loss would increase the capacity in cars. Small bonds with cast terminals of low conductivity are rammed into unreamed holes and the bond crushed in to fill the space in the hole. After a few weeks of pounding the condition of this contact can readily be imagined. There are troubles even with the plastic bonds; the mercury will work through the cork ring which is supposed to enclose it, and the cork will in time harden and crack with the working and pounding of the rails. The amalgam, owing to its high specific gravity, will work out at the bottom of the chamber, and the bond in this case becomes no bond at all.

In Mr. Brown's article no mention is made of the Columbia bonds, and little or no reference to the Johnston bond. No good is spoken of the Chicago bond, and yet I know of roads getting excellent results from all of these. A large contact surface is important and also a high conductivity copper; a hole so placed as to get ample contact surface and reamed to a true taper the same as that on the bond, the latter made of flexible strands proportioned to the current passing. All these are highly important considerations. It is obviously false economy to equip a road with the same size bond 6 miles from the station as that one-quarter of a mile from the same place. A good way to test the bonding of a road is to place two accurate recording voltmeters, one at the station and the other at the end of the line before and after bonding, a careful record of the cars in service and the number of passengers carried being kept during the time of test. The accompanying table gives the record of tests of the power consumption of one car on the lines of the Union Railway Company, New York City, one taken before the road was carefully bonded and the other after bonding with taper terminals in reamed taper holes.

S. H. HARRINGTON,
President of the Harrington Rail Bonding Company.

NEW YORK, January 21, 1898.

Location.	Distance from Power Station in Miles	Amperes		Volts.		Horse-Power.		Remarks.
		Before Bonding.	After Bonding.	Before Bonding.	After Bonding.	Before Bonding.	After Bonding.	
West Farms...	1	35	30	500	510	23.4	20.5	Test made with car 114 before and after Bonding.
Mt. Vernon...	5.7	40	30	425	475	22.7	19.1	
Harlem Station Division Mt. Vernon.....:	5.9	100	65	275	375	36.8	32.6	10 per cent. grade.
Average before Bonding	....	58.3	....	400	....	27.6	....	....
Average after Bonding	....	....	41.8	....	453	....	24.7	....

Saving in one car 2.9 horse-power, which at 3 pounds of coal per horse-power hour and twenty hours daily run gives 174 pounds daily; saving in 85 cars, 14,790 pounds daily; 85 cars 365 days, 2400 tons per year.

To the Editor of The Electrical World:

SIR:—The reference by Mr. Harold P. Brown, in his article on the evolution of the rail bond, to the amalgamated contact method used in the railway line at Orange in 1889 has interested me greatly, as this method was invented by me, and the first bonds were made by me personally, so that it is naturally gratifying to know that the work has stood the test of time so well.

It may be of interest if I give a few particulars of the history of the bond. The rails having to carry very heavy currents, Mr. Edison at once perceived that the bond wires used at that time would not do. He therefore decided to run copper cable through holes in the rails and cast babbitt around them. The difficulty came in how to get the sides of the rails clean so that the babbitt could make contact with the rail as well as with the cable. An electrically driven emery wheel was used, mounted on a car, but the work went slowly. Mr. Edison then asked me if I could not get some way of taking off the scale chemically. I tried this with acids, but found that after this treatment the rail rusted very quickly again, and it then occurred to me to plate it by painting it with copper salts. The film of copper did not, however, adhere firmly, but could be rubbed off. Another solution, whose remarkable properties I had discovered quite accidentally some months previously in other work, was then used, and found satisfactory. This left a polished gray coating on the iron which did not rust. It was, however, still acid, which seemed to me objectionable, and after some further experiments I found that the addition of sodium amalgam gave the required results, forming an amalgam with the iron through the intermediation of the metal coating previously deposited. Up to this time no method had been known of amalgamating iron in the cold, the amalgam having previously been prepared by electrolysis or from iron solutions, but never having been amalgamated directly.

REGINALD A. FESSENDEN.

ALLEGHENY, PA., January 14, 1898.

Digest of Current Electrical Literature

American and Foreign.

by Carl Hering.

Dynamos. Motors and Transformers.

SINGLE PHASE MOTORS. Eborall. Lond. "Elec. Rev.," Jan. 14.—The first part of an article on general notes on such motors, of which he says there now exist several types which leave little to be desired. In the present portion he discusses the constant magnetic field motors, that is, the ordinary reversed alternator class, which has but a very limited application; he discusses their characteristics and the methods of making them self-starting, including an illustrated description of the Brown motor as made some years ago; the well-known disadvantages are summed up. An illustrated description of the one made by the Fort Wayne Company is given, and he considers this one of the best single phase high frequency motors in the market at the present time.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," Jan. 7 and 14.—The beginning of a serial article, the first portions of which relate to the materials, and more particularly to illustrated descriptions of methods of measuring the permeability and the hysteresis loss; the properties of iron are also discussed.

SHIELDING CONDUCTORS. Price. Lond. "Elec. Rev.," Jan. 14. The first half of an article discussing the question of the force and induction when a conductor is buried in the iron of an armature; this he does by the aid of a number of diagrams showing the magnetic distribution. Such conductors are shielded by the iron, so that only a very small part of the flux passes through them at any given instant, and therefore the force acting on the conductor is correspondingly small. He discusses what he calls a remarkable statement made in the recent article on this subject by Du Bois, from which he quotes.

SLOTTED AND SMOOTH CORED ARMATURES.—Lond. "Elec. Eng.," Jan. 14.—Answers by Fennell and by Bell to the question what the chief advantages and disadvantages are of these two kinds of armatures. The former favors the slotted armature, but the latter believes that for large units there is a doubt which is best, but for small ones the slotted core is the better.

DESIGN OF A SHUNT DYNAMO. Zingler. Lond. "Elec.," Jan. 14.—The conclusion of his article (see *Digest*, last week). He shows how the various parts of the magnets and coils are calculated.

AVOIDING SPARKING. Fisher-Hinnen. Lond. "Elec.," Jan. 14.—A translation, with the illustrations, of the article noticed in the *Digest*, Jan. 22.

VIRTUAL E. M. F. OF ALTERNATORS. Knudsen. "West. Elec.," Dec. 25.—The second portion of his article which was noticed in the *Digest*, Dec. 25.

Lights and Lighting.

MAXIM INCANDESCENT LAMP. Maxim. Lond. "Lightning," Jan. 6.—A short article on his new lamp. He has made a great variety of them, and it appears that he can obtain a considerable saving: he is sure of 25 per cent., and thinks he can save 33 per cent.; the filament is made and treated by a new plan, and with the aid of a new mercury pump, which quickly and cheaply produces a vacuum considerably higher than that in the ordinary lamps, he is now able to make lamps of 2.5 watts per candle and less, which will last 1000 hours, some having even tested 1200 hours; the greater part of the filament is carbon, but the resistance and density is increased by the addition of a compound consisting of several substances, which he does not describe; he thinks it will be difficult to drive out the non-conducting material which they contain. He is now getting ready to make a quantity of these lamps; he sees no reason why he should not put into the market lamps which in light-giving power and life will be considerably better than the best now in the market; he thinks he will be selling lamps within six months. One of the new features is that the filaments are subjected, before mounting, to a much higher temperature than has been heretofore possible, and this tends to prevent changes from taking place after it has been mounted; it requires but a very slight increase in the temperature in order to increase greatly the light giving power.

ALTERNATING LAMP. Henrion system. Lond. "Elec. Rev.," Jan. 7.—A translation of the description noticed in the *Digest*, Dec. 18.

Power.

ST. ANTHONY FALLS.—Lond. "Elec.," Jan. 14.—An illustrated description of this power plant at Minneapolis.

DEVELOPMENT OF WATER POWER IN AMERICA AND EUROPE. Kershaw. Lond. "Lightning," Jan. 6.—A short article giving brief details of some of the more important plants.

MECHANICAL STOKING.—Lond. "Elec. Eng.," Jan. 14.—Answers to the question as to the relative advantages of hand and mechanical stoking for central stations, with special reference to the economy and the smoke produced.

DUST DESTRUCTORS.—Lond. "Elec. Rev.," Jan. 14.—Several more communications.

DISTRIBUTION OF POWER. Webber. "Amer. Mach.," Jan. 20.—A short article pointing out the large losses of energy in mechanically driven factories, and discussing the relative cost of steam and water powers; it is very favorable to the use of electric power.

GRAIN ELEVATOR. Dunlop. "Elec. Rev.," Jan. 27.—A brief illustrated description of the Great Northern Elevator at Buffalo, which is operated electrically.

OPERATING COSTS OF STEAM AND ELECTRIC POWER. Taylor. "Elec. Eng.," Dec. 23, Jan. 13 and 20.—In this continuation of his serial (see *Digest*, Jan. 1) he gives a large number of tables showing the fuel and water costs and total cost of steam power for a number of different cases.

Traction.

SURFACE CONTACT SYSTEM. Pierard. "L'Elec.," Jan. 15.—An illustrated description of the Demeuse system, in which there are successive contact points with which connection is made by a long bar carried by the car. The advantages claimed are simplicity of the system, the robust nature of the construction, and the cheapness; a fine wire and a coarse wire magnet attract an armature, which closes the switch, putting the contact point into circuit.

COST OF CURRENT FOR TRACTION.—Lond. "Elec. Rev." Jan. 14.—A discussion of a short article from the "Railway World," on the question of what a fair price is for railway power obtained from lighting stations. The nature of the demand is considered, and it is thought that the maximum charge ought not to exceed four cents, in view of the steady use of the current. The article is reprinted also in "El'ty," N. Y., Jan. 26.

ACCUMULATOR CAR.—Lond. "Elec.," Jan. 7; reprinted in "El'ty," N. Y., Jan. 19.—An abstract, with some of the data, of a brief description of the one used in Berlin, noticed in the *Digest*, Jan. 22.

ACCUMULATOR TRACTION. FitzGerald. Lond. "Elec. Eng.," Dec. 31.—Some supplementary information to his table which was noticed in the *Digest*, Jan. 15.

RULES AND REGULATIONS FOR STREET RAILWAYS IN BERLIN.—"Elek. Zeit.," Jan. 13.—The beginning of a reprint of a long official document concerning the electrical lines in Berlin.

MUNICIPALIZATION OF TRAMWAYS. Baynon-Harris. Lond. "Elec. Eng.," Jan. 14.—The beginning of an article on the juridic side of this question.

DOVER.—Lond. "Lightning," Jan. 6.—A short illustrated description of this municipal railway.

CONDUIT ROADS IN AMERICA.—"St. Ry. Rev.," Jan. 15.—A short review of the progress of these roads in this country. The article seems unfavorable to this system; it is not thought that it would be extended outside of Washington and New York.

CONDUIT CONSTRUCTION IN BERLIN.—"St. Ry. Rev.," Jan. 15.—A very brief description, with an illustration, of the system which is being installed.

WASHINGTON.—"St. Ry. Rev.," Jan. 15.—A brief illustrated description showing some of the work done by the Capital Traction Company.

ELECTRICITY AND TRUNK LINE RAILWAYS.—"El'ty," Jan. 26.—A short editorial in which an unfavorable view is taken of the replacing of steam by electrical energy.

OPERATION AND MAINTENANCE OF A POWER HOUSE. Gurchy. "St. Ry. Rev.," Jan. 15.—A continuation of his article, which refers to the electrical equipment.

RELATION OF STREET RAILWAY AND MUNICIPAL CORPORATIONS. Burdett. "St. Ry. Rev.," Jan. 15.—A reprint of a very long portion of his argument in behalf of the Street Railway Association before a committee of the legislature to report on the relation of street railways and municipal corporations in Massachusetts.

MOUNTAIN RAILWAY.—"Jour. of El'ty," Dec.—A brief illustrated description of the line up Mt. Lowe, in California.

REPAIR SHOP.—"St. Ry. Rev.," Jan. 15.—A long illustrated description of the repair shop of the Chicago City Railway.

Installations, Systems and Appliances.

CUTTING-IN-GEAR AT TRANSFORMER SUB-STATIONS.—Lond. "Elec.," "Elec. Rev.," and "Elec. Eng.," Jan. 14;

and "Lightning," Jan. 13.—An illustrated description of the Walton gear for controlling a number of transformers in sub-stations without the direct manual action of an attendant. At the sub-stations there is a bank of transformers, each one of which is automatically cut in by the switch gear as soon as those which are in circuit are being overloaded; this is done by means of switches operated by solenoids, which release a heavily weighted lever, which in turn throws the switches; the secondary switches are closed first, thus magnetizing the transformer before the primary is switched on, thereby preventing an impulsive current rush into the primary coils; there is no provision for cutting out the transformers as the load falls, as this is done by hand by an attendant. The system is in operation at one of the sub-stations of the Metropolitan Company.

SWITCHING TRANSFORMERS IN AND OUT OF CIRCUIT. Schlatter. Lond. "Elec.," Jan. 14.—A translation, with the illustrations, of the article noticed in the *Digest*, Nov. 20.

CHARGING FOR ELECTRICAL ENERGY. Wright: Claude. "L'Ind. Elec.," Jan. 10.—A communication by the former and a reply by the latter, supplementary to the article by the latter noticed in the *Digest*, Dec. 11. The price in Brighton seems to be limited by the act of Parliament to 15 cents, and it is for this reason that certain customers are still a source of loss. The objections to the Claude system he believes are the same as those which he has repeatedly made to the Hopkinson system, namely, that it tends to prevent the consumer from installing the largest possible number of lamps in all the rooms. He more particularly disagrees with Claude in the suggestion that the company ought to realize a profit in part on the amount of machinery necessary to supply each consumer, and in part on the actual sale of the energy; to realize a profit on the producing material is, in his opinion, contrary to commercial considerations. Claude, in his reply, maintains his preference for his system, although he feels partially converted; in summing up, he concludes that the two characteristics of a system are a tax on the plant proportional to the maximum power of the consumer, and on the price per kw hour, decreasing with the coefficient of consumption.

METHOD OF CHARGING IN MUNICH.—"Elek. Zeit.," Jan. 13.—A description of what seems to be a rather complicated system of rebates used in a municipal station in Munich.

BERLIN AND PARIS.—Lond. "Elec. Eng.," Jan. 14.—A short note giving some statistics. In Berlin there are 300,000 incandescent lamps of 16 candle-power, besides several thousand arc lamps; the length of mains is about 186 miles, and the power developed about 28,000 horse-power; there are also about 1600 motors, requiring 6450 horse-power; the price for lighting is 15 cents per kw hour, and for power 4 cents per kw hour. In Paris, where 25,000 horse-power is used, there are 418,000 lamps of 10 candles and 7448 arc lamps, the length of mains being 240 miles; there are 513 motors requiring 1940 horse-power, and the price charged is 23 cents per kw hour.

CENTRAL STATIONS IN THE UNITED KINGDOM.—Lond. "Elec.," Jan. 14.—The usual annual supplement in the form of a map showing the location of the central stations in the form of colored indications, distinguishing between continuous and alternating current stations, those owned by municipalities and by companies, and those in progress; those within the metropolitan area are shown separately. It shows a steady and rapid growth during the year.

DUESSELDORF.—"L'Ind. Elec.," Jan. 10.—An abstract of the article noticed in the *Digest*, Jan. 1.

CO-OPERATIVE PLANT.—"Amer. Mach.," Jan. 20; reprinted in the "Elec. Rev.," Jan. 26.—A short article giving the general outline of a proposed plant for city lighting at Madison, Wis.

Wires, Wiring and Conduits.

CIRCUIT BREAKERS IN POWER TRANSMISSION. Tapley. "Elec. Eng.," Jan. 27.—An article in which he analyzes the true purpose of the protecting devices, and discusses more particularly the fact that the device should not only protect the motor, but also the machine which that motor is driving, referring more particularly to printing machinery; he shows that the cost of the motor is only one-tenth of that of the printing machine, and that it is therefore of much greater importance to protect the machines than the motor; for such protection he favors the circuit breaker, which he claims has accomplished the results successfully, while the fuse has failed.

BURNING OF INSULATOR PINS. Stuart Smith. "Jour. of El'ty," Dec.—A short article describing a peculiar experience in which the wooden pins of insulators were burned off. Experience on lines in California has shown that a good insulator is not the only requisite to the maintenance of a high voltage line; in one case where 10,000 volts had been in use for a year, it was found that during the storms of the second winter the pins began to give way, the most common method of destruction being that the pin is burned off just abreast of the lip of the inner pettticoat, as is shown in an illustration; this was generally considered to be due to heavy leakage over the surface, but he believes to have shown that the burning is probably due to sparks passing horizontally between the pin and the lower edge of the inner petticoat; pins burned in this way are never found on lines with a potential of 5000 volts, but on those of 10,000 volts they are frequent, while above this plain wooden pins are rendered impossible. It is thought that the use of a device like a porcelain sleeve on the lower portion of the pin would prove effective, as the sparking would then take place between incombustible surfaces; or a narrow metal band could be placed around the wooden pin.

Electro-Physics and Magnetism.

PERPETUAL MOTION OF THE SECOND DEGREE. Frank. "Elektrochem. Zeit.," Jan. 1.—The first part of a long theoretical article on energy in general and its production, properties, etc., in whch he describes various forms of perpetual motions of the second degree, by which term, suggested by Ostwald, is meant a machine which will lift a weight, and is actuated entirely by the cooling of a reservoir of heat. In one form he suggests the following: If a piece of bismuth and one of antimony are brought together and placed in an air thermometer, they will become cool when a current is passed from the bismuth to the antimony; moreover, from Volta's discovery it follows that bismuth is negatively electric and antimony positive; if the bismuth is connected to the earth the charge on the antimony will become doubled; if the antimony is then connected to the earth the charge will become doubled on the bismuth, but in the opposite direction; these alternate connections may be repeated, and an intermittent current will then flow from the bismuth to the antimony in the same direction as that which will cool the junction; the quantity of electricity may be increased wih the aid of condensers, and the connections may be made with the aid of a pendulum operated by the electric current; thus electrical energy will be obtained of unlimited amount without any change in the metals, or absorption of any chemical energy, the only thing being consumed is the heat of the surrounding air. He then discusses the matter at some length; he shows that every cell is a perpetual motion of this kind, to which expensive chemical processes evolving heat are uselessly added; it depends upon chance whether such a cell will heat or cool itself, and there is therefore no particular temperature coefficient for a galvanic cell, as it depends on the mass of the metal, the form and size of the surface, and the nature of the action of the electrolyte on the metal; an electrical pendulum is said to have been operated thirty-five years with the well-known Zamboni dry pile; it is thought to be possible that with a combination of three metals in a place of equal temperature a constant current can be generated, the energy coming from that in the surrounding materials; he shows how the energy of the cell could be calculated directly from the empirical formula for the E. M. F.; for instance, the work done by a current of 1 ampere flowing for an hour though a platinum copper contact is calculated to be 0.329 gram-calories; the measurements of Jahn gave 0.320. Other perpetual motions of this kind are suggested. He then discusses at great length the subject of vortex atoms, showing that such perpetual motions must be possible also on this basis.

CONDUCTIVITY OF DISCONTINUOUS CONDUCTING SUBSTANCES. Branly. "L'Eclairage Elec.," Jan. 8; "L'Ind. Elec.," Jan. 10; "L'Elec.," Jan. 15; abstracted briefly in Lond. "Elec.," Jan. 7.—A brief extract of a French Academy paper supplementary to the one noticed in the *Digest*, Jan. 8 and 22. He holds that no sharp division can be made between continuous and discontinuous conductors; the continuous metallic grains surrounded by an insulating medium can be regarded as a conductor; in visibly discontinuous conductors in which the proportion of insulating material is sufficient, the variations of conductivity, instead of being persistent, as they are generally, disappear directly after they have been provoked by the spark; for a still greater proportion of the insulator the variations cease to occur. The longer portion of the original is devoted to drawing an analogy between the conductivity of radio-conductors and that of the nerves.

DEPOLARIZATION AT LOW TEMPERATURES. Abegg. "L'Eclairage Elec.," Jan. 1; abstracted from the "Wied. Ann.," 62, p. 240.—An article on the speed of depolarization and inductive power at very low temperatures. He found that at this low temperature the E. M. F. of polarization remains constant during a long time; the results of Dewar and Fleming are therefore not beyond question and cannot give the exact values for the inductive power. He replies to a criticism of his formula, which Dewar and Fleming applied only to liquids; he applied it to the results for ice and found it agreed.

CALCULATION OF ELECTRICAL PRESSURE. Mebius. "L'Eclairage Elec.," Jan. 1; abstracted briefly from the "Wied. Ann.," No. 61, p. 638.—He determined the expression for the electrical pressure by supposing that an insulating conducting sphere located in a medium whose inductive power is unity, undergoes the following cycle of transformations: the sphere is charged, the temperature is then raised, the sphere is discharged, and the temperature is then diminished to the initial value.

APPLICATION OF IMAGINARY QUANTITIES IN ALTERNATING CURRENT PROBLEMS. Guilbert. "L'Eclairage Elec.," Jan. 8.—A short article supplementary to the one by Janet, noticed in the *Digest*, Jan. 8.

INDUCTIVE POWER AND ELECTRIC ABSORPTION. Drude. "L'Eclairage Elec.," Jan. 8; translated at considerable length from the "Wied. Ann.," 61, p. 466.—He describes measurements of the inductive power and the electric absorption of substances in small quantities by means of electric waves in wires.

VISCOSITY OF INSULATING LIQUIDS IN A CONSTANT ELECTRIC FIELD. Quincke. "L'Eclairage Elec.," Jan. 1; abstracted from the "Wied. Ann.," 62, p. 1.—The viscosity of

liquids increases when they are placed in a constant electric field; he describes researches made in this direction.

DIELECTRIC CONSTANTS. Ferry. Lond. "Elec.," Jan. 14.—A brief abstract of the article noticed in the *Digest*, Nov. 27.

ELECTRO-CAPILLARY PHENOMENA. Behn. "L'Eclairage Elec.," Jan. 1; abstracted from the "Wied. Ann.," 61, p. 748.—He endeavored to verify the result of the theory of Warburg, that the variation of the superficial tension of the mercury at the contact of the electrolyte is due to the dissolution of the mercury in the electrolyte. He found that the E. M. F. does not depend on the state of the mercury in the acid containing the sulphate of mercury.

MOTION OF A CHARGED BODY. Heaviside. Lond. "Elec.," Jan. 14.—A short article on the motion of a charged body at a speed equal to or greater than that of light. He points out a fallacy in previous remarks on this subject and asserts that a single charged body can move at any speed equal to or greater than that of light.

ELECTRIC CAPACITY OF AN ANNULAR CONDENSER. Boulgakoff. "L'Eclairage Elec.," Jan. 8.—A mathematical article in which he obtains the expression for the capacity of an annular condenser.

ELECTRIC DISCHARGES IN RAREFIED GASES. Melani. "L'Eclairage Elec.," Jan. 1.—A long abstract of the article which was noticed in the *Digest*, Oct. 9.

ROENTGEN RAYS.—Lond. "Elec. Eng.," Jan. 14.—A note on a recent paper by Webster read before the Röntgen Society, in which he remarked that for quick exposures it is highly advantageous to use a thick glass plate between the photographic plate and the subject; by arranging a mirror the process of exposure might be watched by removing the back slide behind the photographic plate; short exposures with a heated cathode gave the best results.

RECOMBINATION OF GASEOUS IONS. Rutherford. Lond. "Elec.," Jan. 14.—A brief abstract of the article noticed in the *Digest*, Nov. 27, under Gases Exposed to Röntgen Rays.

TRANSFORMATION OF X-RAYS BY METALS. Sagnac. Lond. "Elec.," Dec. 31; "L'Elec.," Jan. 15; reprinted in "El'ty" (N. Y.) Jan. 12.—An abstract of the paper noticed in the *Digest*, Sept. 4.

ABSORPTION OF ROENTGEN RAYS. Humphreys. Lond. "Elec.," Jan. 14.—A brief abstract of the article noticed in the *Digest*, Nov. 27.

BEHAVIOR OF ARGON IN X-RAY TUBES. Callendar and Evans. Lond. "Elec.," Jan. 14.—A reprint of their British Association paper.

MAGNETIC PROPERTIES OF TEMPERED STEEL. Sklodowska-Curie. "L'Eclairage Elec.," Jan. 1, and "L'Ind. Elec.," Jan. 10.—An abstract of a recent paper describing researches made for determining the construction of permanent magnets. The bar was heated in an electrical furnace made of platinum wire and was then tempered in water; the heating current magnetized the bar, the magnetization being measured; he thus found that the bar takes the temper only if the temperature is higher than that of the "magnetic transformation," that is, while the steel is feebly magnetic at the time of the temper. The magnetic qualities of the steel are characterized by the intensity of the remnant magnetization on closed magnetic circuit, and by the coercive field, on the strength of which depends the stability of the magnetism and the possibility of magnetizing short bars. He examined a series of steel having an increasing percentage of carbon, and found that those containing 1.2 per cent are the best for magnets. He also examined special steels; he found that various metals in steel do not in general modify materially the remnant magnetism, but that often they increase the coercive field, and it is the increase of this field which improves certain steels for permanent magnets; silicon, boron and manganese do not seem to have any influence; nickel, chromium and copper in small proportions improve the qualities, but the best steels are those containing tungsten or molybdenum: the coercive field can exceed 60 per cent. for carbon steels; it is 70 to 74 per cent. for tungsten steels and 80 to 85 per cent. for the molybdenum steels. He also investigated the effects of shocks, variations of temperature and external magnetic actions, on the magnets; shocks produce less effect as the coercive field is greater; annealing at 200° alters the good steels considerably, 700° being already too much; annealing at only 60° is sufficient, taking care to partially demagnetize them after having magnetized them to saturation.

MAGNETIZATION OF A CORE COVERED ONLY PARTLY WITH A COIL. Sauter. "L'Eclairage Elec.," Jan. 1; abstracted from the "Wied. Ann., 62, p. 84.—He investigated the principal course of the lines of force in a core which is only partly covered by the coil, in which there is therefore a leakage along the surface; the results are shown in curves which are reproduced in the abstract. The second portion of the article is theoretical. When applied to the Gramme ring this analysis leads to the conclusion that the field of the armature current is equal to a field of a uniform intensity equal to eight times the number of windings multiplied by the current in one of them and divided by π.

MAGNETIC VISCOSITY. Klemencic. "L'Eclairage Elec.," Jan. 1; abstracted with some of the curves from the "Wied. Ann.," 62, p. 68.—He describes experiments made with the magnetometric and the ballistic methods. He found that the magnetic viscosity decreases as the intensity of the field increases, the decreasing being more rapid as the wire is finer; the viscosity seems to diminish spontaneously with time, and seems to exist only immediately after annealing.

MAGNETIC SCREENS. Erskine. "L'Eclairage Elec.," Jan. 1; abstracted from the "Wied. Ann., 62, p. 145.—He discusses the question of magnetic screens in oscillating dampened fields.

FERRO-MAGNETIC HYPOTHESIS. Hay. Lond. "Elec.," Jan. 14.—A brief criticism of Fleming's recent hypothesis, in which some of the statements he thinks are misleading.

CHARGING A SPHERE TO VERY HIGH POTENTIALS. Morse. "Elec. Eng.," Jan. 27.—It is well known that a proof plane, which is introduced into the interior of a metal sphere, will transfer all its charge to the sphere. He therefore suggests that an unlimited quantity of electricity at any potential may thus be carried into the sphere and imparted to it by repeated introductions of the electrified proof plane; unusually high potentials might thus be obtained. Several methods of performing this repeated operation mechanically are suggested.

ROENTGEN RAY NOTES. Rollins. "Elec. Rev.," Jan. 26.—A continuation of his long serial. He argues that the wave length depends on the velocity of the impacts on the target and he describes, with the aid of illustrations, a number of movable cathode tubes.

MOTION OF THE ETHER.—"El'ty," Jan. 12.—A reprint of the note noticed in the *Digest*, Dec. 25.

Electro-Chemistry and Batteries.

PRECIPITATION BATTERIES. Lorenz. "Zeit. f. Elektrochemie," Jan. 5.—Some time ago he described a general electrochemical method for producing the hydro-oxides of the metals, in which the electrolyte does not change; it consists in making the metal whose hydro-oxide is desired the anode opposite a cathode of platinum, copper oxide or similar suitable material, in suitable electrolytes; when a current is passed through the metal will be dissolved and the oxide will be formed as a precipitate, the electrolyte remaining the same. He now applies this same principle to primary batteries in which a similar precipitation takes place and in which therefore the electrolyte is continually regenerated, therefore not requiring to be renewed. One of these he made of amalgamated zinc, an oxide of copper plate and chloride of sodium; at the copper plate the precipitation of the hydro-oxide of zinc is formed and sinks to the bottom. Tests of such cells are described, and it was found that the voltage was very constant for the same current strength, but varied very greatly with different current strengths; he found that the behavior was quite similar to that of the well-known Lalande battery; he found that the fall in the voltage seems to take place mostly at the anode; the E. M. F. on open circuit is nearly a volt. Other similar combinations are suggested. His conclusions are that such batteries act well for small currents such as half an ampere per 100 sq. cm.: it is not thought that they will compete with other batteries; one of the objections is the fact that the precipitate must be removed; they may be of interest, however, in the production of energy from coal; one of the methods for solving this problem is to change the chemical energy of coal into another form of chemical energy from which a current can be directly obtained; in such a cell as the one above described the precipitate might be reduced by coal, and thus converted back into the metal.

ACCUMULATOR CONSTRUCTION. FitzGerald. Lond. "Elec. Eng.," Dec. 17.—A continuation of his long serial. He discusses the chemistry of the oxides of lead in connection with the theory of the secondary battery. In the issues of Dec. 24 and 31 he continues the discussion of the oxides of lead, giving their properties. In the issue of Jan. 7 he begins the discussion of the theories of accumulators, and shows the difference between exo-thermic and endo-thermic compounds. In the present portion he also makes some remarks showing the scope of the present series of articles; these he says "are written for practical men having a scientific foundation of elementary physics and chemistry, with a view to aid them to design and make reversible lead batteries, or accumulators, not as they have been, but as they should be, constructed." In the issue of Jan. 14 he discusses the expressions for potential and kinetic energy in mechanics and makes comparisons with chemical actions.

MANGANESE DI-OXIDE IN LEAD ACCUMULATORS. Knorre. Lond. "Elec. Eng.," Jan. 7.—A brief abstract of the article noticed in the *Digest*, March 27. This note is reprinted (without acknowledgment) in "El'ty," N. Y., Jan. 19.

OXIDE OF COPPER BATTERY.—Lond. "Elec. Rev.," Jan. 14.—A translation of the article noticed in the *Digest*, Jan. 22.

IMPROVEMENT IN LECLANCHE CELLS.—"L'Elec.," Jan. 15.—A note stating that with a solution of 5 per cent. of the chlorhydrate of ammonia and 5 per cent. of glycerine the evaporation will be diminished considerably, and the creeping salts and insoluble crystals of the zinc compound will no longer be formed.

SEPARATING COPPER FROM THE POSITIVE METALS. Neumann. "Zeit f. Elektrochemie," Jan. 5.—The beginning of a long article in which he describes electrolytic methods for separating copper from positive metals, such as nickel, cobalt, iron and zinc.

SEPARATING METALS. Revay. "Zeit. f. Elektrochemie," Jan. 5.—The beginning of an article in which he describes researches made to separate electrolytically copper from silver, mercury and arsenic.

THE ELECTROLYTE IN COPPER REFINING PROCESSES. Ulke. "Zeit f. Elektrochemie, Jan. 5.—A short article on the electrolyte, its contamination, treatment, etc., in the American refineries.

IMPURITIES IN ALUMINUM AND ITS ALLOYS. Defacoz. "L'Eclairage Elec.," Jan. 8; abstracted from the "Comptes Rendus," 125, p. 1174.—Descriptions of some researches.

THERMIC EQUILIBRIUM IN ELECTROLYSIS. Tommassi. Lond. "Elec. Rev.," Jan. 14.—A short article in which he solves the following problem: "Given a chemical compound capable of being oxidized or reduced, find out how it behaves when it is brought at the same time into the presence of a reducing and an oxidizing substance, which are considered to be equal and contrary forces." He then deduces the following laws: "When a body is subjected to two equal and contrary chemical actions, the reaction which gives off the greatest quantity of heat will be the most likely to be produced, provided that it can be begun." "With two chemical reactions, the one that requires the least heat to begin will always be produced in preference, even if it gives off less heat than the other reaction." He lays stress on the fact that the laws are true on the express condition that the reaction between the two bodies brought together can be begun.

DEPOLARIZATION OF MERCURY AND PLATINUM. Klein. "L'Eclairage Elec.," Jan. 1; abstracted from the "Wied. Ann.," 62, p. 259.—In order to study separately the polarization of the two electrodes he made one very small and the other very large. His experiments brought out the following results: that the rapidity of polarization varies with the state of the surface and the time that the electrodes are left to themselves; the size of the surface has no effect; the rapidity diminishes when the time during which the E. M. F. acts increases; the anode polarization disappears more slowly than that of the cathode; an increase of temperature produces an increase in the rapidity of depolarization; the latter for platinum is smaller than for mercury. This is followed by a theoretical discussion.

HYDRAULYSIS AND CATALYSIS. Platner. "Elektrochem. Zeit.," Jan. 1.—An article on this subject in which he describes his repetition of the experiments of Warburg and of Paschen, with some modifications; he endeavors to show that there is a "hydrolytic" dissociation of the salts in their solutions.

ELECTROLYSIS OF MIXTURES. Schrader. Lond. "Elec. Rev.," Dec. 31.—An abstract of the article noticed in the *Digest*, June 19.

ELECTRO-CHEMISTRY IN 1897. Weyer. "Elektrochem. Zeit.," Jan. 1.—A review of the past year in which he discusses each branch separately, referring briefly to a very large number of articles, giving in each case the reference to the original publication; the article is quite long, and judging from the number of references, amounting to 132, it appears to be quite a complete review.

ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY. Hess. "L'Eclairage Elec.," Jan. 1.—A review of the past year taken largely from recent articles by Kershaw and by Ulke, both of which were duly noticed in the *Digest*.

EXTRACTING GOLD. Andreoli. "Eng. and Min. Jour.," Jan. 22.—A short article in which he calls attention to the admirable results obtained by the Rand Company, which he believes to be the only one in the world which recovers its gold electrolytically from cyanide solutions; he believes that American and Australian miners must now look to this method as the only practical efficient and cheap one for the precious metals. He then calls attention to the disadvantages of using soluble anodes which contaminate the solution, which can then never be exhausted, the utmost extraction being 70 and 80 per cent. of the gold; the anodes should be absolutely insoluble; iron is used at the present, but it is not the proper material, but those made of peroxidized lead resist the action perfectly; he has subjected these to very trying tests which they stood perfectly satisfactory; they will last for years. The cathodes which he recommends are of iron, from which the gold is stripped by dipping them in molten lead.

ELECTRO-CHEMICAL AND ELECTRO-METALLURGICAL INDUSTRIES. Kershaw. "El'ty.," Jan. 5 and 12—In this continuation of his serial (see *Digest*, Jan. 1) he discusses the Siemens and Halske gold recovery process; also electro-galvanizing and the electrolytic extraction of zinc from its ores.

Units, Measurements and Instruments.

DETERMINING THE EFFICIENCY OF DYNAMOS. Routin method. "L'Elec.," Jan. 15.—A description of this method, in which the losses themselves are determined, which renders the efficiency determination more accurate; it has an advantage over the Hopkinson method in that it does not require two identical machines. The losses are separated into four different parts, and those which are not easily calculated are determined by measurement; the resistance losses in the armature magnets can readily be calculated; the losses by hysteresis and Foucault currents, and those due to friction and ventilation, are then determined by this method. In determining the friction losses the machine is made to run as a motor up to a speed above the normal, and the current is then cut off; the diminution in speed as a function of the time is then measured, more particularly in the neighborhood of the normal speed; the retarding force, which is caused only by friction and ventilation, is then calculated; this is done by drawing a curve showing the variation of the angular velocity as a function of the time; at about the normal speed this will be practically a straight inclined line; in order to eliminate certain elements in the formula which it would be difficult to calculate a second similar test is made, in which a small prony brake increases the retardation of the speed, and a second curve is constructed, the work absorbed by the brake being measured; the power absorbed by the mechanical resistances is then equal to the power absorbed by the brake, multiplied by the tangent of the angle of the second curve, and divided by the difference of the tangents of the angles of both the curves, the angle being measured below the horizontal line representing the normal speed, the abscissa representing the time. To determine the losses due to Foucault currents and hysteresis, the same test is made, only that the field is excited during the whole test; the power lost is then equal to that lost by friction, multiplied by the difference of the two tangents, and divided by the tangent of the angle for the first friction resistance test. The efficiency is then calculated in the usual way, knowing all the losses. The test with the prony brake might be omitted, but it is of interest to know the separate elements of the losses; the method is sufficiently accurate for practical purposes; the brake ought to absorb about 5 per cent. of the full power of a machine; by this method large machines may be tested when only a small amount of power is available.

CLARK STANDARD CELL. Dearlove. Lond. "Elec.," Jan. 14.—A short article in which he gives his experience, which seems to have been quite extended, with the preparation of different forms of Clark cells. The lag may be regarded as of small importance; the life varies according to the usage, one of his cells having been in good service for more than fifteen years; for exceptional accuracy the high temperature coefficient is a defect which cannot well be avoided. There is an almost general complaint that the reproduction of the cell is difficult; he has made hundreds of them, none of which have been unsuccessful; a batch of twenty of different types were recently made, in which the process of preparation was varied, especially with regard to the sulphate solutions; these he describes, and gives the results of tests; the uniformity of the first sixteen cells leaves little to be desired, the maximum variation between them being not higher than 4 in 10,000; the five cells made to the Board of Trade specifications, however, were neither uniform nor constant; he recommends that those who have been unsuccessful in reproducing the Clark cell according to the official specifications should try the method mentioned in the original paper, which was published in 1873, and which is the way he made those referred to. He never obtained bad results from boiling the zinc sulphate, to which Lord Rayleigh objected; the electrolytic method of amalgamating the platinum spirals was found unsatisfactory. In conclusion he gives some results of tests with the Weston cadmium cells made in 1892.

LOCALIZING FAULTS IN SUBMARINE CABLES. McGill. Lond. "Elec. Rev.," Jan. 7.—A brief description of a modification of the Kennelly break test, which is intended to be read in conjunction with Cann's article, published in that journal Dec. 18, 1896 (see *Digest*, Jan. 9, 1897).

TEST OF FAULTS IN SUBMARINE CABLES. Cann. Lond. "Elec. Rev.," Jan. 14.—Some remarks on the subjects mentioned in Murphy's letter, noticed in the *Digest*, Jan. 22.

MEASURING APPARATUS. Armagnat. "L'Eclairage Elec.," Jan. 8.—Well-illustrated descriptions, apparently taken from patent specifications, of various recent improvements in measuring instruments, among which are some meters.

MAGNETIC MEASUREMENTS.—See abstract of an article above on electric generators, by Parshall and Hobart.

WATER RHEOSTATS.—"Jour. of El'ty," Dec.—A short article on the use of such rheostats, including an illustrated description of one used in testing high voltage alternators and arc light machines.

DETERMINING THE THICKNESS OF AN OIL FILM BEARING. Wadsworth. "Jour. Frank. Inst.," Jan.—The conclusion of his recent article, which appears to be similar to the one abstracted in the *Digest*, Oct. 9, under the specific resistance of oil.

Telegraphy, Telephony and Signals.

WIRELESS TELEGRAPHY. Selby. Lond. "Elec.," Jan. 14.—A reprint of a paper read before the Royal Society of Victoria, describing experiments, successful and otherwise, which he conducted with Hertzian waves some years ago.

EFFICIENCY OF TELEPHONE TRANSFORMERS. Lefevre. "L'Ind. Elec.," Jan. 10.—An extract with some of the curves, tables and diagrams of the article by Reding, which was noticed in the *Digest*, Oct. 23, Nov. 27 and Jan. 1.

TELEGRAPH.—Lond. "Elec. Eng.," Jan. 14.—A summary of the last of the series of lectures by Lodge, which were intended for a youthful audience. An abstract is published in "El'ty" (N. Y.), Jan. 26.

DUPLEX IRREGULARITIES. Finn. "Tel. Age," Jan. 16.—The beginning of a reprint of an article on the irregularities introduced into the quadruplex working, due to the use of dynamos in the place of batteries.

INDEPENDENT TELEPHONE COMPANIES.—"Elec. Eng.," 27.—A reprint of a letter issued by the Independent Telephone Association.

Miscellaneous.

IGNITION OF FIRE DAMP AND COAL DUST BY ELECTRICITY. Heise and Thiem. "Elek. Zeit.," Jan. 13.—A continuation of their report (see *Digest* last week). The present portion refers to the experiments with incandescent lamps in the ex-

plosive mixtures. The glass bulbs of a number of lamps were removed, and the filaments were made to glow in the gases; explosions took place, especially at the moment when the filament parted. Tests were then made by breaking lamps in the gases, a number of the results of which were very favorable, and, in general, the results were uniform; the results are given in geat detail in a large full-page table; from this it appears that the small 2-cp accumulator lamps of 6 volts are not safe; 10-cp lamps of 65 volts are quite safe; 16-cp lamps of 65 volts were not safe, while those for 100 and 150 volts were safe; whether the current is direct or alternating seems to make no difference; 25-cp lamps of 110 volts are not safe, while those of 150 were safe, as also those of 25 candle-power at 220 volts, the danger with these being a short circuit between the filaments, which can be avoided by proper construction; the higher candle-power lamps of 100 volts are not safe; all those that were safe at the usual voltage became unsafe when the proper voltage was greatly exceeded. They explain these results by showing that it is not a question of the quantity of energy, but of the current strength; currents up to 0.6 amperes are safe, but above that are unsafe. When a lamp is broken, the gases enter and cool the filament, which, after that, glows again and finally burns out; if the lamp is broken when the filament has been cooled by this influx of the air, there is no danger of explosion; in lamps with thin filaments the filament always broke before the bulb did. When the nipple was broken off while in the gases, so as to admit the air slowly, no explosion took place, which is thought to be due to the fact that the gases are decomposed, so that the mixture is on longer explosive by the time the filament burns out; when the nipple was broken before the lamp was in circuit, the filament was burnt out without causing an explosion.

FATALITIES FROM LOW-VOLTAGE ALTERNATING CURRENTS. Kolben. "Elek. Zeit.," Jan. 13.—A communication referring to the article noticed in the *Digest*, last week. From the nature of the system of three-phase currents which was used in that installation, it appears that if one of the lighting circuits not connected with the neutral wire was grounded it is possible to have a voltage of 230 from the others to the earth, and he believes that it is likely that this was the case in the fatalities cited. He then describes a case in which a man, in falling, grasped the two bare wires of a 200-volt, three-phase circuit with his two hands, and was so cramped that he could not let go until the circuit was broken; he was therefore subjected to 200 volts for several minutes and although he fainted after being released, he recovered very quickly. He believes that contact with a hand and a foot is, however, much more dangerous than between the two hands, as the current is likely to pass through the spinal column in the former case.

REMOVAL OF SCALE. Cowper-Coles. "Lond. "Elec. Rev.," Jan. 14.—A short article in which he describes a process for removing the hard scale on forgings and plates of iron or steel. One of the difficulties is overcome by making the iron alternately the anode and the cathode, in a pickling vat, of which he gives an illustration; the solution is also heated by steam; for catching the scale soon after it is removed, which prevents unnecessary consumption of the acid, the solution is circulated through a chamber behind which are electromagnets, which attract the scale, and nable it to be removed. In America a process has been tried in which a solution of sulphate of soda, or sulphuric acid, is used, the plates to be cleaned being the negative electrode, and the hydrogen which is set free reduces the oxide and decomposes any grease. Attempts have also been made to peel off this oxide with powerful magnets after it is loosened by a short immersion in an acid bath, or by heating.

SPEED INDICATOR.—"L'Ind. Elec.," Jan. 10.—An illustrated description of the Volta indicator noticed in the *Digest*, Nov. 6, which is based on the Arago disc experiment.

EXPERIMENTS WITH STEEL-NICKEL ALLOYS. Guillaume. Lond. "Elec.," Jan. 7.—An abstract, with some of the data, of the paper noticed recently in the *Digest*.

PROCESS OF MAKING STEEL.—Lond. "Engineering," Jan. 14.—A well illustrated description of the Tropenas process, to which attention was called in the *Digest* some time ago, and which is said to yield a very good quality of steel for magnets.

REVIEW OF THE PAST YEAR.—"L'Eclairage Elec.," Jan. 1 and 8.—An article by Raveau on the progress of the science of electricity and by Reyval and Pellissier on the progress of the electrical industries.

PRESIDENTIAL ADDRESS. Raworth. Lond. "Elec. Eng.," Jan. 14.—A reprint in full of his address before the Northern Society of Electrical Engineers. It appears to be general in character. An abstract is published in Lond. "Elec. Rev.," and a more brief one in the Lond. "Elec."

BIOGRAPHICAL.—Lond. "Elec.," Jan. 14.—A short biographical sketch of Joseph Wilson Swan, the president of the Institution of Electrical Engineers.

ELECTRIC INVESTMENTS.—Lond. "Lightning," Jan. 6.—A short survey of the English market.

ELECTRICAL JOURNALS OF THE WORLD.—"L'Ind. Elec.," Jan. 10.—A revised list, brought up to date, of all the electrical journals pubished.

ACCUMULATORS IN DENTISTRY.—"Jour. of El'ty," Dec.—An article giving an elementary description of accumulators and their uses in dentistry.

PRESIDENTIAL ADDRESS. Higgins. "Elec. Eng.," Jan. 27.—An abstract of his presidential address before the Northwestern Electrical Association.

MAGNETIC CONCENTRATION.—"Sc. Am.," Jan. 22.—A well illustrated description of the Edison Concentration Works.

Book Reviews.

THE INDUCTION COIL IN PRACTICAL WORK; Including Röntgen Rays. By Lewis Wright. Cloth, 12mo, 172 pages, 72 figures and 4 plates. Published by the Macmillan Company, New York. Price, $1.25.

Interesting and practical, this little book might have been yet further condensed in size by the omission of the chapters on elementary electricity at the beginning.

ELECTRICITY IN ELECTRO-THERAPEUTICS. By Edwin J. Houston and A. E. Kennelly. Second Edition. Cloth, 16mo, 452 pages, 147 illustrations. Published by the W. J. Johnston Company, New York. Price, $1.00.

This second edition of this interesting little book has been made complete by the addition of a chapter on Röntgen rays, and their application in medicine and surgery.

FIRST PRINCIPLES OF ELECTRICITY AND MAGNETISM. By C. H. W. Biggs, editor of the *Electrical Engineer* (London). Cloth, 12mo, 494 pages, 350 diagrams, etc. Published by Biggs & Co., London. Price, $1.25.

A book for beginners in practical work. Unfortunately, it is written for English readers only, and has little reference to American machinery and methods, but notwithstanding this it is a good, practical, sensible text-book for an intelligent beginner, and requires no mathematical attainments whatever on the part of its reader.

THE ELEMENTARY PRINCIPLES OF MACHINE DESIGN is the title of a booklet just published by the Industrial Publishing Company, New York, the author of the work being Mr. J. G. A. Meyer. The subjects treated of embrace the proportions of connecting rods, piston rods and pistons for steam engines; cotter joints, screw wrenches, etc., and full instructions for setting a plain slide drive and eccentric are given. It also gives practical and explanatory hints for making all the necessary calculations and working drawings. The little work is well illustrated and the text is simple and accurate. The price is 25 cents per copy.

THE PRINCIPLES OF ALTERNATE-CURRENT WORKING. By Alfred Hay. Cloth, 12mo, 280 pages, 119 diagrams. Published by Biggs & Co., London. Price, $1.50.

This is an exceedingly elementary text-book, in which the author endeavors to make plain the difficulties of alternating currents. After an introduction, in which the methods of vector analysis are very simply presented and a discussion of fundamental laws and principles, harmonic analysis is taken up. Succeeding chapters deal with the practical applications of single-phase and polyphase alternatinng currents. It is a good and timely book. The arrangement followed is that of the usual school text, numerous examples and questions being incorporated.

PRACTICAL ELECTRICITY, VOL. I. By W. E. Ayrton, F. R. S. Cloth, 12mo, 643 pages, 225 illustrations. Published by Cassell & Co., Limited, London.

This new edition of this well-known and excellent book has been brought up to date by an entire revision. Instead of adding a patchwork of new chapters, Professor Ayrton has chosen to entirely rewrite the book, and made it practically a new one. The six chapters included in this volume comprise: The Electric Current and Its Measurement, Galvanometers and Ammeters, Difference of Potential and Resistance, Laws and Measurements of Resistance, Electric Energy and Power, and Galvanic Cells. Three appendices treat of Lines of Force Diagrams, Silk for Galvanometer Suspensions and the History of the Absolute Unit of Resistance, etc.

THEORY OF ELECTRICITY AND MAGNETISM. By Charles Emerson Curry, with a preface by Prof. Ludwig Boltzmann. Cloth, 12mo, 440 pages, 32 diagrams. Published by the Macmillan Company, New York. Price, $2.50.

This rather elaborate and deeply mathematical work follows the lines of Professor Boltzmann's lectures to his students at the University of Munich, and is a sort of exposition or elaboration of Maxwell's treatise. The distinction between the analogies employed to illustrate ether phenomena and the actual condition of things in the ether itself is sharply marked throughout the work, which has thus the great advantage of lack of confusion—unfortunately characteristic of but few such works.

There is a considerable space devoted to Helmholtz's theory of electricity and magnetism, while recent interest in Röntgen rays has caused the author to insert a brief disquisition upon Helmholtz's longitudinal ether waves. The book is to be commended in many respects, especially for the excellence of its arrangement.

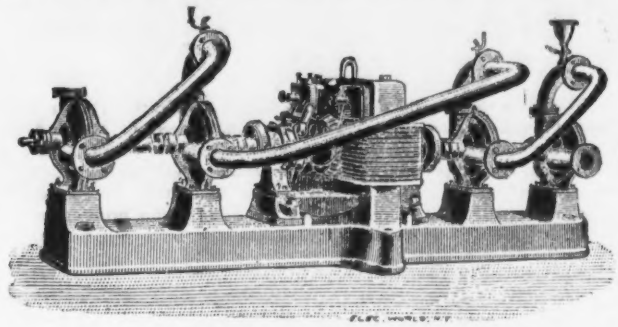
ENGINEERING AND ARCHITECTURAL JURISPRUDENCE. A Presentation of the Law of Construction for Engineers, Architects, Contractors, Builders, Public Officers and Attorneys at Law. By John Cassan Wait. Cloth, 8vo, 905 pages. Published by John Wiley & Sons, New York. Price, $6.00.

The need of a work such as this is greater now that the field of engineering practice has so grown and widened. No longer limited to the construction or supervision of works, engineers are now as well advisors and counselors in the promotion and investigation of enterprises and in the examination of experts and the rebuttal of their testimony. Since attorneys at law are not, generally, familiar with the details of engineering, it becomes necessary often for the engineer to know something of law.

This excellent work is intended to give an engineer some of that knowledge of law which will enable him to avoid litigation and to aid him in protecting his own rights and those of his employer. It is almost invaluable to those engineers who undertake contract work. It is an admirable work, simply written, well arranged, fully indexed and very complete. It will be found a useful tool by many engineers.

A Simple Motor-Driven Pump.

The accompanying illustration shows an ingenious arrangement of French design for raising water to considerable heights by power derived from electric



MOTOR DRIVEN PUMP.

motors Instead of belting or gearing the motors to slow running pumps with reciprocating plungers, valves, etc., the motor is coupled direct to centrifugal pumps, and to obtain increased elevating power over that obtainable from one such pump, a number is coupled together on the same shaft and connected hydraulically in series. In the illustration a four-part pump is shown which is capable of raising the water against a head of from 125 to 200 feet. The arrangement is obviously much simpler than that of a motor-driven plunger pump for the same purpose. The device is made by the house known as Pompes Dumont, 55 Rue Sedaine, Paris, France.

Improved Telephone Induction Coils.

The subject of telephone induction coils has received the special attention of the Varley Duplex Magnet Company, Jersey City, N. J., and as a result improved apparatus of this character has been produced. The object of the company was to make induction coils best adapted to the various transmitters on the market, and to meet other conditions which are constantly arising in practice, and which usually baffle telephone manufacturers. The Varley Company has perfected some automatic winding machines for accurately winding induction coils and telephone magnets. These machines not only produce accurate results, but are primarily designed to turn out coils at a low price without any loss of efficiency.

The advantages of the Varley magnet coils are well known, and every care is taken in their construction. In Fig. 1, the new special 500-ohm telephone induction coil is shown in perspective, and Fig. 2 shows a sectional view of the same. The latter illustration is self-explanatory in every detail. It shows that the coil is built up after the Ruhmkorff principle, and no matter what the intensity of the current in the primary may be, there is no loss or brush discharge inside of the coil, in consequence of which the coil acts as a highly efficient transformer. Another noticeable feature is the winding of the coil in two halves, each half being wound in a direction opposite to that of the other. The terminals of the secondary windings are, as a consequence, brought out from the top layer of each half. The two half sections are separated by fibre disks. After winding, the coils are thoroughly baked and boiled in paraffin. With two dry batteries, the coil is capable of producing a quarter-inch spark when used in connection with a small condenser. This result would be impossible to attain if the coil were wound in one winding, for the reason that the actual distance between the top and bottom layers of the secondary would then be only one-eighth of an inch; hence considerable internal losses would result when working the coil at a maximum.

FIG. 1.—SPECIAL TELEPHONE INDUCTION COIL.

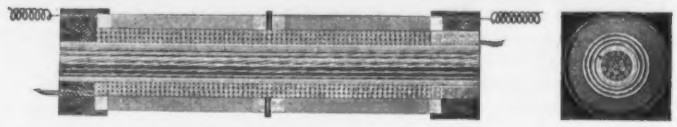


FIG. 2.—SECTION OF TELEPHONE INDUCTION COIL.

Fig. 3 represents the new gas lighting spark coil of the Varley Duplex Magnet Company. This company's spark coils are already well known throughout the trade, but this last production is said to be an advance over the 1897 coil.

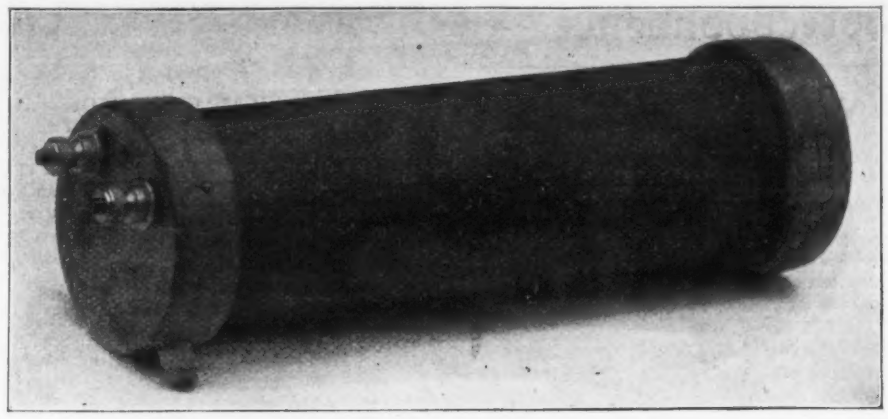


FIG. 3.—GAS LIGHTING SPARK COIL.

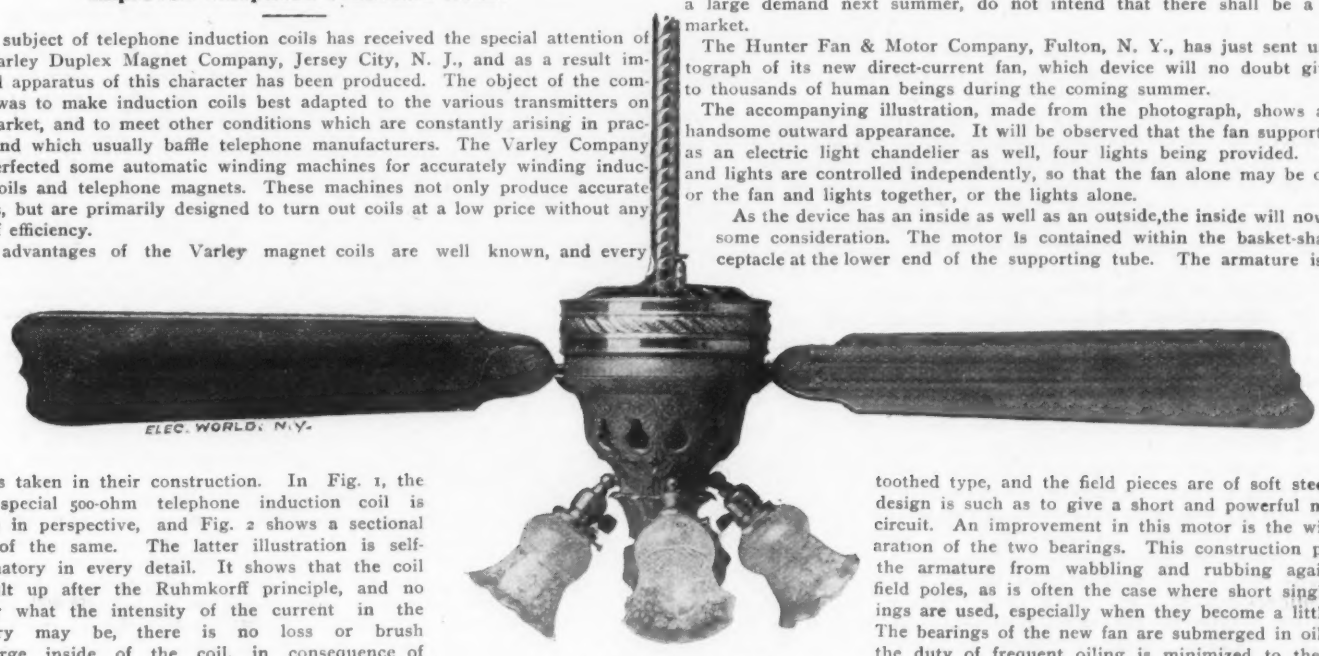
New Direct Current Fan.

In this latitude it seems a little early just now to refer to devices designed for keeping the air cool, but the manufacturers of such apparatus, anticipating a large demand next summer, do not intend that there shall be a "short" market.

The Hunter Fan & Motor Company, Fulton, N. Y., has just sent us a photograph of its new direct-current fan, which device will no doubt give relief to thousands of human beings during the coming summer.

The accompanying illustration, made from the photograph, shows a fan of handsome outward appearance. It will be observed that the fan support is used as an electric light chandelier as well, four lights being provided. The fan and lights are controlled independently, so that the fan alone may be operated, or the fan and lights together, or the lights alone.

As the device has an inside as well as an outside, the inside will now receive some consideration. The motor is contained within the basket-shaped receptacle at the lower end of the supporting tube. The armature is of the toothed type, and the field pieces are of soft steel. The design is such as to give a short and powerful magnetic circuit. An improvement in this motor is the wide separation of the two bearings. This construction prevents the armature from wabbling and rubbing against the field poles, as is often the case where short single bearings are used, especially when they become a little worn. The bearings of the new fan are submerged in oil, hence the duty of frequent oiling is minimized to the lowest practical limit, one supply of oil lasting the entire season. On the bottom of the fan is provided a two-speed switch, by means of which the fan can be operated at one of two different speeds. Next to the fan itself comes the question of current consumption. In this fan the consumption is said to be small, being less than one ampere, with the blades revolving at a speed of 192 r. p. m. The sweep of the blades is 5 feet.



NEW FAN FOR 1898.

News of the Week

Financial Intelligence.

THE NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY has declared a regular quarterly dividend of $1.50 per share, payable on February 15.

THE ST. LAWRENCE POWER COMPANY, of Massena, N. Y., on January 25 filed with the Secretary of State at Albany a certificate of the payment of its entire capital stock of $6,000,000.

THE NEW ORLEANS TRACTION COMPANY reports gross earnings for December of $107,926, a decrease of $1995 as compared with the same month of the previous year, and net $45,399, an increase of $8457. For the year ending December 31 the gross earnings were $1,237,250, a decrease of $85,576, as compared with the corresponding period of the previous year, and net $399,869, a decrease of $184,284.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 31, 1898.

MR. WILLIAM S. TURNER has opened an office as consulting and constructing electrical and mechanical engineer at 120 Liberty Street, New York.

MR. SETON M. SCOTT, late mechanical engineer for the Kelly & Jones Company, Greensburg, Pa., has opened an office at 120 Liberty Street, as a consulting mechanical engineer.

MR. HUGO REISINGER, the well-known manufacturer of "Electra" carbons, has moved to a handsome suite of offices on the fourth floor of the elaborate new office building, 11 Broadway.

THE CABLE RAILWAY running through Montague Street in Brooklyn, from the Wall Street Ferry to Court Street, will probably be equipped with electric power on the underground trolley system. The change will be accomplished at an early date, and will cost, it is said, about $100,000.

THE SPRAGUE ELECTRIC COMPANY occupies the entire fifteenth floor of the new Commercial Cable Building, 20 Broad Street, and has a most elegant suite of offices. The company is to establish branch offices in Chicago and other cities.

HENRY ELECTRICAL SOCIETY.—The ninety-sixth meeting of the Henry Electrical Society will be held at Columbia University, Engineering Building, Room No. 302, on Friday, February 4, at 8:15 P. M., when Mr. A. H. Ford will deliver an experimental lecture on "Transformers."

MUNICIPAL OWNERSHIP will form the subject of a debate between Messrs. E. M. Grout and Allen R. Foote, to be held at the Educational Alliance Hall, in this city, on February 16. Mr. Grout will advocate such ownership, while Mr. Foote will support the opposite view.

ELECTRIC CARS ON AMSTERDAM AVENUE.—The residents of Amsterdam Avenue and the Boulevard were surprised on Sunday, January 30, to see electric cars pass by their houses. The electric service on this division of the Metropolitan Traction Company's system was then inaugurated, and traffic was carried on with a limited number of cars. The new electric service extends from Sixty-fifth Street, up the Boulevard to Seventy-second Street, thence up Amsterdam Avenue to 126th Street. The power is obtained from the 146th Street station.

AMONG THE WELL-KNOWN ELECTRICAL MEN present at the banquet of the Manufacturers' Association of the United States last week, at which President McKinley made an address, were Col. A. B. Chandler, president; Mr. E. H. Johnson, vice-president and general manager, and Mr. W. E. Mandelick, of the Sprague Electric Company, New York; Messrs. Charles M Wilkins, Franklin S. Carter and E. Ward Wilkins, the entire firm of Partrick, Carter & Wilkins, Philadelphia; Mr. George Bullock, president of the Bullock Electric & Manufacturing Company, Cincinnati. Mr. W. E. Sessions, of the Sessions Foundry Company, Bristol, Conn., was also present.

A MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS was held at 12 West Thirty-first Street, on the evening of January 26. It was devoted to the discussion of the question of standardizing generators, motors and transformers. The discussion was opened by Mr. E. W. Rice, Jr., and was participated in by Messrs. Lozier, Kennelly, Wolcott, Hutchinson, Mosscrop, Lieb, Dunn, Coho, Pattison, Henshaw, Steinmetz, Mailloux and Osterberg. The appointment of a committee to consider the question was suggested, and the whole matter was finally referred to the Council for such action as it may deem proper. At the meeting of the Council in the afternoon thirteen gentlemen were elected associate members.

BUYING UP ELECTRIC RAILWAY FRANCHISES.—It is stated that a syndicate has secured control of the rights of the People's Traction Company and the Westchester & Connecticut Traction Company to build trolley lines in that part of New York City east and north of the territory served by the Union Railway Company. Mr. P. H. Flynn, of Brooklyn, and W. A. Boland, of New York, are said to be at the head of the syndicate. It is stated that the work of building the new road will be commenced in May. A special meeting of the two companies named above was held on January 28, and W. A. Boland was elected president, Silas B. Dutcher vice-president, and Fred C. Cocheu secretary and treasurer. Mr. Flynn stated that the companies had franchises to build 40 miles of road, and that they would proceed to do this in the best possible manner. The first line to be built will be out to Mt. Vernon on the Boston road.

THE KINGSBRIDGE RAILWAY COMPANY, which was incorporated at Albany, N. Y., on January 25, is the first step toward the building of the Kingsbridge extension of the Third Avenue Railway. To all intents and purposes the new company, though a distinct organization, will be a part of the Third Avenue Company. Its line will be operated in conjunction with the latter's system, and only one fare will be charged from the post office to the Yonkers line. The new road will be 8 2-5 miles long, and will begin at 125th Street and the Boulevard, and will run north as far as the Yonkers city line. The directors of the Kingsbridge Railway Company will apply to the Municipal Assembly for a public hearing, preliminary to an application for a franchise. As soon as the franchise is obtained work will be commenced, and it is expected that the road will be finished in about sixty days thereafter. The road, it is thought, will be in operation by the early summer.

THE ELECTRICAL EXPOSITION.—We are informed by the management of the Electrical Exposition that Prof. Francis B. Crocker has accepted the position of consulting engineer for the Exposition Company. Professor Crocker is deeply interested in the success of the exposition, and signifies his desire to promote its influence and work in every way. His name as consulting engineer of the company is a guarantee that all the work coming under his supervision will be of a character commensurate with the importance of the exhibition. The exposition management is to be congratulated on such a valuable acquisition to its staff. The announcement is also made that an auxiliary and educational committee has been formed to take charge of exhibition matters other than commercial and to co-operate with the advisory committee of the New York Electrical Society. The Auxiliary Committee includes men of the highest standing, all of whom intend to take an active part in the work. Mr. T. C. Martin has consented to serve in the capacity of chairman of this committee. With him will be associated Prof. F. B. Crocker, of Columbia University; Prof. Morris Loeb, of the University of New York; Prof. W. E. Geyer, of the Stevens Institute of Technology; Dr. Charles A. Doremus, of the College of the City of New York; Mr. Herbert Laws Webb, of the New York Telephone Company; Mr. J. B. Taltavall, editor of the *Telegraph Age;* Dr. Park Benjamin, Secretary G. H. Guy, of the New York Electrical Society; Mr. W. T. Wheeler, vice-president and national deputy National Association of Stationary Engineers; Lieut. G. O. Squier, U. S. A., and Mr. Thomas A. Edison, Jr. Mr. Edison will have charge of some special decorative and mechanical effects at the exposition.

THE RAPID TRANSIT PROBLEM.—A letter from President George Gould, of the Manhattan Railway Company, was read before the meeting of the Rapid Transit Commission on January 24. Mr. Gould stated in his communication that the Manhattan Railway Company, if so authorized, would construct the following connections, extensions and additional tracks and facilities: 1. A connecting line, beginning at Battery Place, and extending along the westerly side of the city to Horatio or Gansevoort Streets, thence through Horatio or Gansevoort Streets to and connecting with the Sixth and Ninth Avenue elevated lines. 2. Also a branch thereof, connecting the west side lines with the City Hall terminal, through Reade or Duane or Canal or Centre Streets, to an extension of the Sixth and Ninth Avenue lines to Fifty-third Street, to Tenth Avenue, thence along Tenth Avenue and the Boulevard and Eleventh Avenue to Fort George. 3. An extension of the suburban line from the Tremont Station through Fordham to Bedford Park. 4. Additional tracks and facilities to increase the ability of the company to properly accommodate the traveling public. On the receipt of the board's approval, the elevated railway company would, he stated, without delay, prepare and submit such formal application and such detailed plans and specifications as may be proper under the provisions of the Rapid Transit Act. The commission considered the letter and adopted resolutions favoring the first proposition; expressing grave doubts as to the advisability of giving the company permission to build a line along the Boulevard; favoring the third proposition, and expressing the opinion that the fourth proposition, on account of its indefinite character, could not be dealt with now in any way. The board was of the opinion that the Manhattan Railway Company should be invited to promptly submit formal applications for such separate extensions as it may desire, to the end that the board may deal with such questions separately, and may treat each point upon its own merits. At the same meeting the counsel of the board was instructed to make immediate application to the Appellate Division of the Supreme Court for a re-hearing in the matter of the bond of $15,000,000 to be required from any contractor who might undertake to build and operate the proposed underground railroad. At a meeting of the directors of the Manhattan Railway Company on January 25, a committee was appointed to prepare a more detailed statement of the company's proposition, in accordance with the resolutions of the Rapid Transit Railroad Commissioners. It is not thought that contracts for the electrical equipment of the line will be given out until after the settlement of the points raised by the Rapid Transit Commission with reference to the letter of Mr. George Gould, president of the Manhattan Elevated Railway Company. The competing electrical companies are meanwhile keeping a close watch on the progress of events, and are primed for aggressive action the moment the proper time arrives.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Jan. 28, 1898.

THE BERNSTEIN ELECTRIC COMPANY, Boston, under the receivership of Gen. Benjamin F. Peach, Jr., will continue the manufacture of its well-known lamps, and fill all orders with promptness.

MR. O. D. PIERCE, general selling agent of the Shelby Electric Company, Shelby, Ohio, has been in Boston for several days, and is making a general tour through New England for the well-known Shelby lamps, scoring some excellent orders. Mr. Pierce is a veteran in the incandescent lamp business, and knows exactly how to "get there" with the trade.

MR. J. C. FISH, secretary and general manager of the Shelby Electric Company, Shelby, Ohio, was recently a Boston visitor. His stay was necessarily short, but was nevertheless sufficiently long to find out that the Shelby lamp was giving the same satisfaction in Boston as elsewhere. All who had the pleasure of meeting Mr. Fish were impressed with his strong social and business qualities.

MR. LOUIS E. HILL, son of that veteran in the electrical field, Mr. Warren S. Hill, has opened up in business for himself, with offices at 154 Congress Street, Boston. He will handle the dynamos, motors and other electrical apparatus of the Maine Electric Company, Portland, Me., and has already made some good sales in Boston and vicinity. He will also handle the Shawmut fuse switches and switchboards and other devices and supplies incident to complete installations. Mr. Hill has always been associated with his father, and is consequently well equipped with electrical knowledge and in the electrical trade has hosts of friends who predict for him the success he deserves.

THE PETTINGELL-ANDREWS COMPANY, Boston, has for a long while realized that it had outgrown its Federal Street quarters, and for some time it has been on the lookout for an abode which would give it increased accommodations. This has been found at 275 Devonshire Street and 5 Winthrop Square, a central location, in close proximity to its present quarters. In its new location it will have over double the present space and facilities. A large corps of workmen are actively engaged in preparing the new quarters for occupancy, and the company will probably be nicely located in them by or about March, when it will have a new home, of which it may well feel proud and such as it abundantly deserves.

THE MAINE ELECTRIC COMPANY, Portland, Me., is now pushing its business aggressively, and its manufacture of dynamos and motors and electrical hoists are selling better than ever. All the apparatus of this company is designed to give the highest efficiency, constructed with the utmost care and with the view of giving absolutely satisfactory service. Its new electrical controller is very highly spoken of, and seems to be a good seller. The company is now broadening out considerably in the electrical field, whereas until recently its operations have been confined principally to the States of Maine and Vermont. Manager J. B. Phillips is determined to make his company more generally known. Mr. Louis E. Hill, whom everybody knows, particularly in New England, represents the company in Boston, with offices at 154 Congress Street.

THE THIRD ANNUAL REPORT OF THE BOSTON RAPID TRANSIT COMMISSION for the year ending August 15, 1897, has been issued from the press of Rockwell & Churchill. This report forms a most complete and elaborate description of the new Boston subway, the descriptive matter being supplemented by a large number of full page heliotype illustrations. Beside the report of the progress of work on the subway by the engineers in charge, there are complete reports of the work on the Charlestown Bridge, and appendices giving in full the contract with the West End Street Railway Company, equipment of the subway, the statistics of traffic, etc. Among the full-page illustrations, of which there are fifty altogether, quite a number are devoted to the Budapest subway to show the comparative appearance and construction of the two systems.

THE NEW ENGLAND REPRESENTATIVE of the Siemens & Halske Electric Company of America has just obtained the contract for the new municipal lighting plant at South Norwalk, Conn. This plant will be of interest to the engineering fraternity in general, as it is to be run on the straight 220-volt, two-wire system for arc and incandescent lights as well as power. Another plant is being installed in the new theatre at Springfield, Mass., in which lights for the entire edifice as well as some adjoining buildings will be furnished from two 75-kw machines running at 100 r. p. m. One of the largest of recent installations, and now in satisfactory operation, is that for a large manufacturing plant in which motors ranging from 10 to 100 horse-power in capacity, aggregating 1000-hp, full-load capacity, with 100 Manhattan lamps and several hundred incandescents are operating from a single set of bus bars at 220 volts, current being furnished by two machines of 400-kw capacity each, with a smaller one for night service. The generators in all of the above mentioned plants are of the standard Siemens & Halske external armature type.

THE H. C. HAWKS COMPANY, Boston, has just announced itself, with spacious and well-equipped offices and salesroom at 190 Congress Street. Its particular business will be the wholesaling of electrical supplies and heavy contract work. Mr. H. C. Hawks, treasurer and general manager, is so well and favorably known as to render unnecessary any special mention. His connection until January 1, 1898, as president of the Anchor Electric Company, kept him in intimate contact with the general electrical trade, and made for him many friends, who have a high regard for his executive ability and uniform business courtesy. His intimate knowledge of electrical construction, owing to his connection with the Hawks Electric Company, well equips him for this class of work, so that the success of the new company would seem to be assured. The H. C. Hawks Company will have the valuable association of Mr. P. P. Crafts, manager of the Hawks Electric Company, who was previously connected with the Brookline (Mass.) Gas & Electric Supply Company and the Massachusetts Electrical Engineering Company, and who ranks among the foremost of electrical engineers.

THE BELKNAP MOTOR COMPANY, Portland, Me., presented unusual business activity in offices and factory upon the occasion of a recent visit. The Chapman voltage regulator is gaining a strong foothold, and orders are coming in fast, and from what General Manager Brown says indications point to a very large business for this valuable specialty. In dynamo and motor work the company is also kept very busy. In fact, the large and well-equipped factory of this company and its competent working force are utilized to the fullest extent. It was only about 1890 that the Belknap Motor Company started in a small way to manufacture water motors. In 1892 it commenced the manufacture of electric motors and dynamos, and at the World's Fair in 1893 it made a creditable display of apparatus, since which time its progress has been onward, until today, with the addition of the Chapman voltage regulator, it is able to present a line of manufactures which commands attention and recognition. Mr. George W. Brown has been the executive chief of this company since its organization, and has successfully piloted it into a snug and safe business harbor. Mr. William H. Chapman, the inventive genius of the concern, has been connected with the company from the beginning, and between Mr. Chapman and Mr. Brown there exists such perfect unanimity in ideas, action and sympathy that the secret of success of the company is not far to seek.

THE BURNHAM-HALL-CHASE COMPANY, 146 Franklin Street, Boston, introduces itself to the electrical trade under most favorable conditions. The particular lines to which it will apply itself will be those of electrical engineering, storage and primary battery installations, telephones, electrical apparatus for physicians, surgeons and dentists and electrical supplies. Mr. W. W. Burnham is very well known to the trade through his prominent and long connection with the Electric Gas Lighting Company, and his admittedly good business judgment, thorough knowledge of the details of the electrical business, indefatigable energy and reliability will unquestionably tell greatly for the success of this new company. Mr. F. A. Hall will represent the technical side of the company. The experience of Mr. Hall was gained on the engineering staff of the Thomson Electric Welding Company, Thomson-Houston Electric Company and General Electric Company, and added to which may be mentioned also association with prominent firms of consulting engineers. While with the Thomson-Houston and General Electric companies Mr. Hall evolved important designs in connection with direct current, railway, light and power generators and stationary motors and other apparatus in connection with the electrical branch of the business. He also possesses a thorough knowledge of storage batteries. Mr. W. B. Chase is the son of Mr. Henry A. Chase, deceased, who was long connected with the Fire Signal Department of Boston as superintendent. Like his father, he possesses inventive ability. This new company will manufacture a new telephone, the invention of Mr. Chase. The new 'phone has received high commendation wherever it has been used, for its clear tone, large volume and other desirable qualities.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., Jan. 29, 1898.

THE SAWYER ELECTRIC COMPANY of this city has secured the contract for wiring the Pennsylvania Institute for the Education of the Blind, at Overbrook. This is one of the largest contracts for wiring ever given in this section of the country.

THE HESTONVILLE, MANTUA & FAIRMOUNT PASSENGER RAILROAD has been leased for 999 years to the Union Traction Company, at a rental of 6 per cent. on $500,000 preferred stock, and 4 per cent. on $2,000,000 common stock. The lease was ratified by a vote of the stockholders of the first named company on January 27. An effort was made to prevent the lease being carried into effect by a legal injunction, but it failed. The entire street railway system of the city is now under one management.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY has just opened for business at 831 Arch Street, and has secured the agency for the Bryant Electric Company, of Bridgeport, Conn. The company expects to secure the agency for a number of other manufacturing concerns. Mr. H. C. Roberts, who is at the head of the new enterprise, was formerly connected with Messrs. Vallee Brothers & Co., of this city, and is experienced in the electrical trade. Mr. Roberts desires to secure trade catalogues and discount sheets.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Jan. 29, 1898.

THE PAN-AMERICAN EXPOSITION is not to include a special electrical building in its list, as the plan is to make everything connected with the fair where light or power is needed such a practical exposition of the actual use of electricity that the entire establishment will be an electrical educator such as has never been seen before. Elaborate preparations for lighting the falls and the Niagara Gorge in a fashion not before attempted in the world are now well under way.

THE GORGE ROAD suffered from a landslide last Sunday that carried off the track some distance on the southern section that rises from the bottom of the gorge to the level of the city of Niagara Falls. Business was suspended till Wednesday, when cars began to run on the section north of the Buttery elevator, where connection was made with the city electric cars. The electrical connections were not deranged, but it will cost $500 at least to make repairs. The break will be filled in with solid masonry.

MR. HORATIO A. FOSTER is now in the employ of the Cataract Power & Conduit Company, making twenty-four-hour tests of existing steam plants that are to be furnished with electric power. Without this work as a basis for estimating the amount of power required it is practically impossible to arrive at figures with any accuracy. Too many expensive mistakes in these estimates have already been made to warrant the continuation of guesswork, for, as a rule, no owner of steam power has much of an idea of the amount he is using.

A NEW ELECTRICAL COMBINATION at Niagara Falls is the Niagara River Tramway Company, which seeks incorporation and a permit to string a cable across the river below the falls, and run cars on it that will carry six or eight people. A Canadian charter has been obtained. The proposed American

charter also contemplates running the cable device along Niagara River from Buffalo to Niagara Falls. A member of the company disclaims any present intention on the part of the company of undertaking anything more than a cable line for crossing the river.

PITTSBURG NOTES.

PITTSBURG, Pa., Jan. 28, 1898.

NEW TROLLEY ROAD CHARTERED.—The Fairmont Electric Railway Company was chartered this week for the purpose of operating a trolley road in Fairmont, and through the counties of Marion, Monongalia and Harrison, W. Va. The incorporators are: John B. Crane, Charles E. Manley, A. Howard Fleming, and Owen S. McKinney, of Fairmont, and Thomas W. Fleming, of New York.

UNITED TRACTION COMPANY CONSOLIDATING ITS POWER PLANTS.—As a result of bringing its underlying companies under a single management, and in order to effect economies in its operating department, the United Traction Company is re-arranging and enlarging the capacity of the P, A. & M. power house, at the foot of Juniata Street. The power house of the Federal Street & Pleasant Valley Company will be abandoned. In view of this change, the United Traction Company is offering for sale a large amount of heavy power machinery, consisting of engines, boilers, stokers and generators of various sizes and makes, together with switchboard apparatus, etc. All the apparatus is now in operation in the power houses of the company.

ENGINEERS' SOCIETY BANQUET.—The Engineers' Society of Western Pennsylvania last night held its annual banquet at the Hotel Henry. A very large number of the members were present, and, as usual, heartily enjoyed the menu served, as well as the post prandial feast. Mr. Thomas H. Johnson acted as toastmaster. Some of the toasts given were: "The Engineer and the Press," by Mr. Arthur G. Burgoyne," "The Engineer and the Railroad," by Mr. Rawdon Evans; "The Engineer and the Law," by Mr. Willis F. McCook; "The Engineer and the Manufacturer," by Mr. E. E. Keeler; "The Engineer and the Ladies," by Mr. Victor Bentner; "The Engineer and Science," by Prof. James E. Keeler, and "The Engineer and Our Society," by Mr. W. G. Wilkins.

BILL IN EQUITY AGAINST THE BRUSH COMPANY.—A bill in equity has been filed in Common Pleas Court No. 1 by John E. Ridall, through his attorneys, J. S. Ferguson and Knox & Reed, against the Brush Electric Company. The complainant alleges that he has an agency contract with the Brush Company giving him the sole right to sell, within certain described territory, apparatus manufactured under patents owned by the Brush Company. Notwithstanding this agreement, the defendant company has sold, and permitted to be sold, by other agents and companies affiliated with the Brush Company a large amount of apparatus in Ridall's territory, upon which the plaintiff claims he is entitled to a commission. A suit has been entered to recover the amount alleged to be due, and the present bill in equity is to compel the defendant company to produce records necessary in the trial of the case.

PROSPEROUS YEAR FOR THE STANDARD UNDERGROUND CABLE COMPANY.—The annual meeting of the stockholders of the Standard Underground Cable Company was held on January 25. From the report of the directors, which was read, it appears that the gross business of the company for the year 1897 amounted to $925,117.45, making the largest in the history of the company. The net earnings over and above all expenses were $97,052.57. During the year dividends were paid amounting to $70,000, and the remainder of the net earnings, namely, $27,052.57, was added to the surplus earnings, which now aggregate $335,094.25. The assets of the company on January 1 were $1,515,160.89, and the liabilities, including $1,000,000 capital stock, were $1,180,068.64. The company's gross business for 1897 was $243,761 in excess of that for the year 1896. The unfilled orders on hand January 1, 1898, aggregated $167,740, which, together with much new business in prospect, gives promise of another successful year for the company. The old board of directors was re-elected unanimously, and is as follows: Mark W. Watson, J. W. Dalzell, James H. Willock, John B. Jackson, George B. Hill, John Morehead, Jr., Robert Pitcairn, B. F. Jones and Joseph W. Marsh.

CLEVELAND NOTE.

CLEVELAND, Ohio, Jan. 28, 1898.

POWER CONSUMPTION ON ELECTRIC RAILROADS was the subject of a paper read by Mr. Samuel T. Dodd before the Civil Engineers' Club, of Cleveland, at its semi-annual meeting in this city on the evening of January 25. Mr. Dodd discussed the resistance developed by moving cars, and reviewed the formulas which have been in common use to express this resistance. He concluded that modern experience shows that the old formulas, while giving results rather high at low velocities, give too small resistances at high velocities when applied to electric motors. He cited instances from the practice of several of the interurban roads about Cleveland, and showed that about 400 pounds per ton was the maximum horizontal effort to be expected from the electric motor. The paper was accompanied by a number of diagrams and tables illustrating the subject.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
986 Monadnock Building,
CHICAGO, Ill., Jan. 29, 1898.

THE CHICAGO EDISON COMPANY has declared its regular quarterly dividend of 2 per cent., payable February 1, to stockholders of record.

MR. J. F. OUTWATER, purchasing agent for the Edison Electric Illuminating Company and the Citizens' Electric Illuminating Company, of Brooklyn, N. Y., was in Chicago last week. This gentleman was very much pleased with the result of his visit to the "Windy City."

MOVING CUTTER'S DEN.—The George Cutter Company has moved its establishment to 100 Lake Street. In announcing this fact on a postal card the company propounds these questions: "How many of the most practical devices known to the electric light men have come from Cutter's den, and how many more may be expected from the larger quarters at 96, 98 and 100 Lake Street, corner of Dearborn?"

IT IS STATED that the suburban trains of the Chicago, Milwaukee & St. Paul Railway Company will soon be operated by electricity instead of steam engines. President Louderback, of the Lake Street Elevated Railway Company, is authority for this statement. He further states that the contracts for furnishing the electric power have been entered into for the North and West Chicago Street Railway Companies. Owing to the fact that ordinances have not yet been secured, the terms of the contract cannot be learned.

THE CHICAGO TELEPHONE COMPANY and the Central Union Telephone Company held their annual meetings in this city on January 19. Both companies report an increase in gross and net earnings for 1897. The Chicago Company gained $116,250 gross, and $24,489 net, and its surplus, after paying 12 per cent. dividend on its outstanding capital was $104,313.47. The Central Union Company gained $103,816 gross, and $39,184 net. It paid no dividends, but had a surplus of $280,393. The report of President W. A. Jackson, of the Central Union Telephone Company, shows that the number of exchanges in operation by the company at the end of the year was 153, an increase of twenty. The number of subscribers on December 31 last was 36,318, an increase of 4,674, and the number of toll stations 1157, an increase of 202.

THE OSBURN ELECTRIC MANUFACTURING COMPANY is the new name for the old Osburn Electric Supply Company of this city. The company has increased its capital and bought a well-equipped factory, and is now manufacturing a great many of the suppplies in which it deals. It is stated that these facilities give the company the distinction of being the only supply house in the West that owns a factory. The officers of the new concern are Mr. H. G. Osburn, president; M. R. Osburn, vice-president and secretary, and L. W. Jones, treasurer. The factory is located at 48-54 North Clinton Street, and the general offices and show rooms are at 294-296 Dearborn Street. The company has in its employ skilled electrical mechanics, and is in a position to manufacture special articles that cannot be found on the market.

FRANCHISES BY THE WHOLESALE.—Various fifty-year street car franchises were applied for at the Council meeting on January 17. The South Side Company asks for the use of several miles of streets, but offers an insignificant car license fee as compensation. The Central Electric Company applied for Washington Street bridge and for the right of way on about two miles of streets from Congress and Greene Streets to Michigan Avenue and Monroe Street. It offered nothing in the way of compensation. The third applicant was for a line to the Wisconsin lakes, and offered to pay $550,000 during the life of the franchise, if the company is given the right of way from the river near State street to the northwestern city limits. The company does not ask for the use of any streets; it proposes to lay its tracks on land it may buy or condemn.

WIRES BLOWN DOWN BY THE STORM.—Telegraph and telephone wires were badly demoralized by the storm on the night of January 22. Snow and sleet weighed them down to such an extent as to cause them to break, besides breaking down a great many poles. The fire department wires were similarly affected, and it required rapid work on the part of City Electrician Ellicott to restore order out of the chaos and get the wires in such shape as to place some reliance on the signal service in case of the outbreak of fire. On the North Side an entire line of poles was broken down on Fullerton Avenue, and in many other streets in that section the same condition of affairs existed. Two hundred fire alarm boxes were put out of service on account of the damage. The Western Union Telegraph Company was completely paralyzed for a while, being without a single wire early in the morning. By 9 o'clock on the morning of the 23d, however, communication was established with Detroit and the East. The Postal Telegraph Company also fared badly, but the local authorities sent out the statement that they had communication with all important points. The telephone service was also badly demoralized, 3000 instruments being cut off in the city system. It will take several days at least to repair the damage that has been done.

AT THE ANNUAL MEETING OF THE CHICAGO ELECTRICAL ASSOCIATION on January 7, 1898, Mr. H. G. Dimmick read a paper on "Electrical Shop Transmission." The paper was confined to the two-wire 220-volt systems, and was full of practical advice derived from Mr. Dimmick's own experience. He took up the two general cases; first, the change from old belt-drive systems, and second, the installation of a complete new outfit. In the former case the opportunity is shown for much ingenious and original work of a temporary nature to keep the machinery running during the time of installation. The use of cables not over 800,000 circular mils cross-section was advised, feeders larger than this being preferably divided. The problem of terminating cables neatly in switches and other fixtures is a serious one. With lead-covered cables, whose insulation is not filled with air and water compounds, an extra large lead sleeve must be wiped on the end of the cable and filled with some compound which will not melt and run out at times of heavy loads. The ideal method of dealing with this problem has not yet appeared. Motor-starting apparatus should be uniform in style over the whole system, and should be all mounted on slate or similar material. Each motor should have a switch, a fuse, a starting box and pilot lamps, and an ammeter is also advisable. The automatic starting boxes are not yet what they ought to be. With 150 motors in operation on as many starting boxes, if the main circuit breaker opens, all these boxes must return automatically to a starting point, or there will be a burn-out when the current comes on again. Mr. Dimmick believes in putting in extra large motors, even if the cost and losses are slightly increased, for the motors will run more slowly and will be less liable to overheating, and the coils, brushes and commutators will last longer. In most manufactories the load is almost certain to be increased by the addition of more machines, and the motors should be able to take up this increased load.

MILWAUKEE NOTES.

MILWAUKEE, Wis., Jan. 28, 1898.

THE EASTERN WISCONSIN TELEPHONE COMPANY, Sheboygan, Wis., has been incorporated, with a capital stock of $5000. The company will put in a telephone system at Elkhart Lake.

THE RECENT SNOW STORMS crippled the street railway lines considerably in this city. The suburban lines were abandoned, and nearly all city lines suspended operations. The Postal Telegraph and Western Union lines were greatly damaged.

THE FOX RIVER VALLEY ELECTRIC RAILWAY COMPANY'S receivers have notified J. H. Taylor, Green Bay, Wis., that they can no more lease the Fort Howard Electric Street Railway. This will result in the two systems being operated separatey.

THE COMMITTEE appointed by the Common Council of Appleton, Wis., to consider the lighting of the city by gas or electricity has reported in favor of electric lights. A proposition to furnish light every night, moon or no moon, at the rate of $65 per lamp year, has been made by the lighting company.

MR. T. F. WHITFIELD has just opened a suite of offices in this city, and will from now on represent the following named companies: Pass & Seymour, Syracuse, N. Y.; Queen & Co., Philadelphia; Charles Wirt, Philadelphia; the Simplex Electrical Company, Boston, and the Columbia Incandescent Lamp Company, St. Louis, Mo.

THE FOX RIVER ELECTRIC STREET CAR COMPANY, Green Bay, Wis., has been placed in the hands of receivers. Plans for the reorganization of the company have been adopted. C. L. Goodrich has been chosen as superintendent under the receivers, and will have charge of the working force of the road. Dr. C. H. Holmes, who was president of the company, will be general manager.

IT IS REPORTED that the Chicago & Northwestern Railway Company is considering the building of an interurban electric road from De Pere to Fond du Lac. The line, if built, will be operated on the same principle as the Illinois Central and Eastern lines operate their suburban roads. It is known that the Chicago & Northwestern Company has an option on the local street railway until February 10, 1898.

AN ELECTRIC RAILWAY connecting Sheboygan, Wis., with the Chicago, Milwaukee & St. Paul Railway at Plymouth, is proposed. John M. Saemann, president of the Sheboygan Electric Railway Company, has made a proposition to the city affecting the proposed road. Mr. Saemann offers to build and equip the road, if the city will give $45,000 to aid the project. The estimated cost is $335,000. The road is to be opened for use by the St. Paul road, and in addition will have passenger trains hauled by electric engines.

MR. JAMES F. KEELYN has awarded, at Eau Claire, Wis., contracts for the building of several telephone lines. M. McGeeham has the contract to build a long-distance telephone line from Ashland to Iron River. J. H. Rareup will build the long-distance telephone lines between Ashland, Ironwood, Hurley and Bessemer. At Duluth arrangements were made for the building of a long-distance telephone line from Iron River to Duluth and Superior, and from Iron River to Orienta, with branches 40 miles long along the lake shore from Back Point to Amnicon Point.

THE EXECUTIVE COMMITTEE of the Board of Fire Underwriters has decided to recommend the election of Mr. Edward M. Dexter as electrical inspector. The position has been vacant since November 1, 1897, when Mr. George McLaren resigned it to go to Mexico as the representative of an electrical concern. Mr. Franklin H. Wentworth, of the electrical bureau, has acted temporarily as inspector. Mr. Dexter will take possession of the new office on February 1. He has been connected for several years with the Wisconsin Telephone Company, and has the indorsement of Mr. W. H. Merrill.

ST. LOUIS NOTES.

ST. LOUIS, Mo., Jan. 27, 1898.

THE BOARD OF PUBLIC IMPROVEMENTS has decided that the electric railways and telephone companies must put all their wires in the commercial districts underground.

MR. HENRY A. COIT, formerly with the Missouri Telephone Manufacturing Company of this city, has established a business as dealer in telephone supplies. He handles high-grade telephone apparatus, and is prepared to quote prices on construction material. Mr. Coit's address is 2923 Washington Avenue.

THE CENTRAL TELEPHONE & ELECTRIC COMPANY, of this city, is the concern that bought the good will and stock of the Missouri Telephone Manufacturing Company. It was not the Central Electric Company, as stated in this correspondence last week. The office and factory of the Central Telephone & Electric Company are at 1123 Pine Street.

THE REAL ESTATE agents in St. Louis met at the Real Estate Exchange this week to decide which of the two rival telephone companies—the Kinloch and the Bell—they will patronize. Nearly all of them at present have contracts of the Bell Company, but quite a number have agreed to patronize the Kinloch. The matter was postponed until later. F. W. Kinsley, of the Electrical Workers' Union, asked that pending the settlement of the union's trouble with the Kinloch Company the real estate men make no contracts.

MEXICAN NOTES.

MONTEREY, Mexico, Jan. 24, 1898.

IT IS LEARNED that a new and extensive electric light and power plant is soon to be installed in the great silver mines of Maximilian Damm, State of Durango. The mines there have produced several millions of dollars' worth of ore, and are still far from being exhausted of their supply of riches.

A LARGE ELECTRIC LIGHT & POWER PLANT is to be constructed in the city of Orizaba, State of Vera Cruz, the estimated cost of which is about $75,000 for the machinery alone. Orizaba is an important and growing city, situated in the heart of the most productive coffee region of Mexico. There are already a number of large industrial enterprises located there, and with cheap electric power other concerns will be established.

ADVICES HAVE REACHED HERE from the City of Mexico to the effect that Mr. T. H. McLean will soon sever his connection with the Federal District Street Railway Company, of that city, as general manager, to take a lucrative position with the Toledo Traction Company, Toledo, Ohio. Mr. McLean has been general manager of the extensive street railway system of the City of Mexico for about three years, and introduced many important improvements, which have resulted in a big increase in net earnings of the system. It is not yet known who will succeed him. There will be a meeting of the board of directors of the company on February 1, when the matter will be acted upon.

THE WORK OF CONSTRUCTING a tram line from the station of the Mexico, Cuernavaca & Pacific road, at Cuernavaca, to the heart of that city, is soon to begin. Mr. W. T. Pritchard, a Chicago capitalist, is at the head of the company. It is the intention of the company to utilize electricity as the means of power as soon as the necessary plant can be installed, but in the meanwhile mules will do the work. There is an abundance of water-power available for the generation of electricity in that immediate neighborhood. Another tram line is being built from Cuernavaca to Tlaltenago, 4 kilometers distant, and still another of the same length, to Atzcapatzingo. The elegant, but now deserted, palace of Maximilian is situated at the latter place, and is quite an attraction for visiting tourists.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., Jan. 22, 1898.

THE MUNICIPAL ELECTRIC LIGHTING SYSTEM of Tacoma, Wash., has been extended so as to supply commercial lights in Glendale. Still further extensions are contemplated.

THE SUNSET TELEPHONE & TELEGRAPH COMPANY will at once construct a telephone line from Taiya (Dyea) across the Chilkoot Pass to Lake Bennett, and later a line from Skaguay via the White Pass to a connection with the former line at Lake Bennett. Superintendent A. C. Sands is in charge of the construction.

THE A. VANDER NAILLEN SCHOOL OF ENGINEERING, of San Francisco, was recently incorporated, with a capital stock of $50,000. The school was opened by Prof. A. Vander Naillen in 1864, and of late years particular attention has been given to its flourishing electric department. R. Leo Vander Naillen has charge of instruction in electrical engineering.

THE JAPANESE CRUISER "CHITOSE," which was launched at the Union Iron Works, San Francisco, January 22, will be equipped with generators, motors and other electric apparatus manufactured in the electrical department of the works. The vessel has a displacement of 4760 tons; length over all, 405 feet, 2 inches; beam, 49 feet; draught, 17 feet, 7½ inches; speed, 22½ knots; I. H. P., 15,500; twin screw engines, 40, 60, 66 and 66 by 36-inch stroke.

THE WESTERN UNION TELEGRAPH COMPANY has decided to enter Victoria, British Columbia, by making use of a heavy submarine cable 18 miles in length. The cable landing on the American side will be in Port Angeles, Wash. The connecting line will be built via Seattle and Port Townsend, Wash. Several shorter cables will be put in at various Puget Sound points in connection with new lines. One will be laid across Hood's Canal. Telegraphic business on the Pacific Coast has increased materially of late.

TROLLEY MAIL SERVICE FOR LOS ANGELES.—The postal authorities have notified the postmaster of Los Angeles, Cal., that the department has decided to establish an electric car mail delivery and collection service. The electric lines will be able to serve in this way Pasadena, Sherman, Garvanza, Highland Park and many smaller places between Altadena and the salt-water terminus in Santa Monica. The suburban mail service will require special electric mail cars to make at least eight round trips per day.

THE LOS ANGELES-PACIFIC RAILWAY COMPANY, which was recently incorporated, is a consolidation of the interests of the Pasadena & Pacific Railway Company, of Arizona, and those of the company of the same name, of California. The capital stock is $1,000,000, divided into 10,000 shares, of which Trustee W. M. Buffum holds 9935 shares. The company intends to construct and operate electric railway lines between Los Angeles, Cal., and Santa Monica, with branch lines to Hollywood, Laurel Canyon, South Santa Monica and Soldiers' Home. The trackage required to complete the system will be about 100 miles.

CANADIAN NOTES.

OTTAWA, ONT., Jan. 29, 1898.

THE RATEPAYERS of Orillia, Ont., will probably be asked to vote at an early day on a proposed power transmission scheme. It is intended to transmit electric power a distance of 12 miles.

THE DESCHENES ELECTRIC LIGHT COMPANY is having plans prepared for a dam to be built at Deschenes Rapids, which will furnish 3000 horsepower. The contract will be let in a few days for the erection of a power house.

MR. A. H. ST. GERMAIN, of North Toronto, is about to organize an autocar service between York Mills and Toronto. He has ordered the electric buses, each capable of carrying thirty persons, from an English firm, and they will be delivered in Toronto before next spring.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Jan. 19, 1898.

GIFT TO THE ROYAL INSTITUTION.—Mrs. Tyndall has just presented to the Royal Institution a gift of £1000 in the name of her late husband, Prof. Tyndall. The money is to be disposed of for the promotion of science as the Board of Managers think fit, no conditions being imposed by the donor. In thanking Mrs. Tyndall for this gift the treasurer of the Royal Institution, Sir James Crichton-Browne said that the managers would probably employ it in the promotion of that original scientific research in which Prof. Tyndall's vivid and penetrating intellect delighted to exercise itself. It is also probable that a bust of the late professor will be obtained by the institution.

THE ENGINEERS' STRIKE.—The strike in the engineering trade has now practically collapsed. The committee of the Amalgamated Society of Engineers have withdrawn their demands for an eight-hour day, and it now only remains for them to accept the terms insisted upon by the Employers' Federation (and provisionally accepted by the men's delegates at the recent conference), relating to the management question, in order to enable the employers to withdraw their lock-out notices and thus put an end to this strike, which has now lasted since July 3 of last year. The men have suffered a severe defeat, for not only has the union's exchequer been drained, but a large number of strikers will find it a hard job to obtain immediate engagements, their posts having been filled by efficient non-union workmen.

A NEW LOW RESISTANCE MEASURER.—A simple and practical instrument for measuring very low resistances, such as those of dynamo and motor armatures, has just been put on the market by the Davies Motor Company, successors to Messrs. Nalder Brothers & Co. A thick platinoid wire 1 metre long and having 0.1 ohm resistance, stretched in front of a boxwood scale, is connected in series with the resistance to be measured, and a current of about ten amperes is passed through the circuit. Two leads, having steel points, are connected to one coil of a very small pivot differential galvanometer, which is fixed to the same boards as the rest of the instrument, and the other coil of the galvanometer is connected between the ends of the stretched wire to a sliding contact maker. The drop of potential over the unknown resistance is thus balanced against the drop over a portion of the stretched wire, and the resistance is read off directly in thousandths of an ohm. In order to give a larger range there is a plug switch by means of which resistances can be connected in series with one coil of the galvanometer, and the constant of the whole instrument thus doubled or halved. The price of the instrument is moderate, and it appears particularly suitable for workshop use.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—On Thursday last Mr. J. W. Swan, the new president of the Institution of Electrical Engineers, delivered his inaugural address. After briefly referring to the fact that it was but sixteen years since he had exhibited his new incandescent lamp in the same lecture hall, he proceeded to review the present development of the electro-chemical industry. It seems probable that the interest in electro-chemistry is being revived in this country; numbers of new processes are being tried on a large commercial scale. The next paper to be read before the institution is also on the same branch of electricity, viz., "Notes on the Electro-Chemical Treatment of Ores Containing the Precious Metals," by Major-General Webber. At the same meeting Mr. Latimer Clark presented to the institution a valuable collection of the late Mr. Jacob Brett's papers. These contain not only his patent specifications, copies of the various contracts which he had made with the cable companies and licenses which he had obtained from the Government at the time of the laying of the first submarine cables, but also interesting cuttings relating to telegraphy from newspapers of that period, letters from his brother, Mr. J. W. Brett, and other most interesting memoranda.

French Notes.

(From Our Own Correspondent.)

PARIS, France, Jan. 19, 1898.

PRIZES DECREED BY THE PARIS ACADEMY OF SCIENCES.—At the public session on January 10 the Academy of Sciences decreed the La Caze prize for physics to M. Ph. Lenard. His labors upon cathode rays very happily completed the researches of Sir William Crookes, and preceded the discovery of the X ray by Röntgen. It can be said that if M. Lenard did not have the good fortune to profit so well by his work as Röntgen, he at least first established that cathode rays, after they come outside of the tube in which they are generated, are capable in turn of exciting phosphorescent bodies, illuminating gases, traversing to various different degrees bodies opaque to light, acting rapidly upon photographic plates, discharging electrified bodies, etc. The academy also awarded the prize founded by Gaston Planté, the celebrated inventor of the accumulator, to M. André Blondel, ingénieur des ponts et chaussées, who earned it by his work in electricity. The increasing extension of alternating current practice necessitated studies much more difficult than those to which continuous currents had given place. It is to this class of studies that M. Blondel has given the greatest attention. In 1891 he determined automatically and by a continuous process of tracing the curves of tension and currents, and indicated for the first time the method of tracing them by photography. This was a great step in progress, for this rapid method permitted at the same time the analysis of the phenomena of which the alternating current arc is the seat, particularly in directly demonstrating the fact that a current of particles is directed from the positive toward the negative carbon; it appeared even to measure the velocity of their passage. But the most important result was the realization of a new type of apparatus, the oscillograph, capable of transmitting to a mechanical system the exact law of variation of currents with time. M. Blondel's remarkable analytical and experimental talents have allowed him to elucidate a number of questions interesting at the same time to both science and industry, such as methods of coupling alternators, a theory of synchronous motors, the use of polyphase current, the discussion of methods for measuring the power and efficiency of machines, etc. The electric arc has been from certain points of view always an object of study for M. Blondel. The absence of difference of phase between the current and the E. M. F. at the terminals of an alternating arc led him to think differently from the opinion widely held since the time of Edlund, that there does not exist in the arc any inverse E. M. F. analogous to that of polarization. An ingenious method recently applied to the continuous current arc seems to confirm this conclusion and demonstrate that the arc is equivalent simply to a resistance. His functions as the engineer attached to the lighthouse service led him to study the photometric properties of the arc. At the suggestion of the director of the lighthouse service, M. Bournelles, to whom is due the invention of the flash-light system, M. Blondel has undertaken a long series of experiments, which have already led to useful improvements in the apparatus of French electric lighthouses.

THE ACCUMULATOR TRACTION SYSTEM AT OSTEND.—The Société Anonyme des Railways Economiques de Liège—Seraing et Extensions and the Compagnie Générale des Railways à Voie Etroite have inaugurated an electric street railway line at Ostend, Belgium, with accumulator cars of a new type. The generating station includes a compound engine of 60 horse-power, running at a speed of 100 r. p. m., and driving by belt a Westinghouse multipolar shunt-wound dynamo, having an output at normal full load of 37.5 kilowatts. The dynamo gives an E. M. F. of 280 volts at a speed of 600 r. p. m. The current from the generator is led to a switchboard of the standard Westinghouse type, divided into three panels. The first is practically a standard dynamo panel, carrying the generator switches and circuit breakers, and the field rheostat. On this panel are mounted also the ammeter and voltmeter. The other two panels, which are precisely alike, are employed to connect the accumulators to the generator. They are arranged for four circuits, with the proper switches, measuring instruments, etc. The rolling stock includes four cars, each equipped with two Westinghouse No. 46 motors wound for 280 volts. The controller is of the series parallel No. 28 A type. The cars are built to seat comfortably twenty-two passengers, and in addition can carry fifteen on each of the platforms. They are lighted by four lamps in the interior and one lamp on each platform. The accumulators are placed under the seats, and access is obtained to them by means of doors on the sides of the cars. Ample provision has been made for ventilating the space allotted to the accumulators, so that no fumes can possibly enter the car. The trucks of the cars are simple in construction. The frames are extremely rigid, and are supported upon springs so well adjusted that the cars roll with remarkable smoothness. The axles are placed 7 feet 6 inches between centres, and the car wheels are 33½ inches in diameter. The accumulators are placed while charging on special platforms in the charging station. These platforms are designed to permit four complete batteries to be charged at one time. The track running between the two series of platforms allows the cars to be moved to the exact point where the batteries are wanted. Each battery consists of twelve boxes, holding nine cells each, giving in all 108 elements for each car. The platforms are arranged so that the batteries are slid laterally from the car with the least possible amount of trouble. Each section box contains sliding contacts at the side, so that when the boxes are in place the contacts are made automatically, and the car is ready to operate. At the present time the company has altogether five complete batteries. Each element is composed of eleven plates 200 millimetres (8 inches) square. The total weight of the battery is 3300 kilogrammes (7000 pounds), and is able to furnish current for the car without recharging, for a 60-kilometre (37 miles) run on the ordinary type of "T" rail. The E. M. F. of the battery at the end of a run of 60 kilometres is about 225 volts. About two hours are required to recharge the batteries. The average consumption of current is about 25 amperes at 250 volts, while the car is in operation, giving a speed of 12 kilometres (7½ miles) per hour, including stops, and about 15 kilometres per hour without including stops. When mounting a grade of 5.5 per cent., with the motors in parallel, the current rises to about 140 amperes, but the car is able to mount this grade at a speed of 14 kilometres per hour. Observations have been taken extending over a long period, showing 610 watts per car kilometre to be the maximum charge given to a battery, while the average charge is about 560 watts per car kilometre. Three cars are continually in service during working hours, the fourth being held in reserve. The hours of service are from 7:40 in the morning until 9 o'clock in the evening. During this time of operation the three cars average 272 kilometres, or 170 miles per day, the running speed in the town being about 15 to 16 kilometres per hour, including stops; the motors are run in series connection. Outside of the town proper, however, where a speed of from 30 to 40 kilometres per hour is customary, the motors are worked in parallel, with all resistance thrown out. The results of a series of trials with the trail car attached to the motor car is given below. The weight of the motor car, including batteries and passengers, is about 13 tons, and the weight of the trail car, including passengers, is approximately 7 tons. The tests was made upon Vignole rails and on level track: Motors coupled in series—24 amperes, 208 volts; speed, 11.5 miles per hour. Motors coupled in parallel—54 amperes, 200 volts; speed, 18.5 miles per hour. It is proposed in the very near future to double the size of this plant, as its success has been quite remarkable.

General News.

New Incorporations.

THE NEW TELEPHONE COMPANY has been incorporated at Indianapolis, Ind., with a capital stock of $350,000.

THE STANART LIGHT & POWER COMPANY has filed its charter with the Secretary of State at Austin, Tex. Among the incorporators are E. A. Ellis, L. Ashton, C. H. Alexander. Capital stock, $100,000.

THE NASHVILLE LIGHT & POWER COMPANY, Nashville, Tenn., has been formed with a capital stock of $25,000. Among the incorporators are: C. M. McGhee, L. D. Tyson, N. Baxter, Jr., Shelby Williams and E. G. Connette.

THE PHILADELPHIA ELECTRIC LIGHT, HEAT & POWER COMPANY, Philadelphia, Pa., has been organized with a capital stock of $1,000. The incorporators are: G. R. Green, J. R. Embery, H. R. Barramore, J. J. McCarthy and Henry Watts

THE CONSOLIDATED ELECTRIC COMPANY, Troy, N. Y., has filed articles of incorporation at Albany, with a capital stock of $10,000. The directors are: E. L. Ashley. E. J. West and Mrs. E. H. Ashley. The principal office will be at Fort Ann, with a branch office at Glens Falls.

THE CHICAGO & DESPLAINES VALLEY ELECTRIC RAILWAY COMPANY has been incorporated at Chicago, Ill., with a capital stock of $1,000,000. The incorporators are: Henry G. Foreman, Charles D. Evans, Philip H. Gray, William H. Hulbert and Clayton E. Crafts, all of Chicago.

THE KINGSBRIDGE RAILWAY COMPANY, of New York City, N. Y., has been incorporated with a capital stock of $1,000,000. The directors are: Henry Hart, Edward Lauterbach, Albert J. Elias, Charles Remsen, Henry Iden,

David C. Andrews, G. Howland Leavitt, Andrew H. Waydell and John Byrns, all of New York.

THE SOUTHERN MINNESOTA TELEPHONE COMPANY, St. Paul, Minn., has been organized with a capital stock of $30,000, for the purpose of establishing a system of telephone lines throughout Murray, Cottonwood and Pipestone counties. The incorporators are: Charles and Ace Webster, F. T. Fallows, Thomas A. Way and T. A. Potter.

THE SANDUSKY, NORWALK & TOLEDO RAILWAY COMPANY, Toledo, Ohio, has filed articles of incorporation. The company, with a capital stock of $1,000,000, is organized for the purpose of building an electric road from Sandusky to Norwalk and from Sandusky to Toledo. The incorporators are: Charles H. Rudd, W. W. Graham, A. J. Stoll, Henry G. Fowler and W. E. Guerin, Jr., all of Sandusky.

THE CITIZENS TELEPHONE COMPANY, of Westchester County, N. Y., has been organized with a capital stock of $3,000. The officers of the new company are as follows: Robert S. Haviland, president; Dr. E. P. Swift, vice-president; Albert See, treasurer; C. W. Pahe, secretary; H. W. Bullock, electrician. The directors are: R. S. Haviland, E. P. Swift, S. Wood Cornell, Daniel P. Hayes, Thomas Bell, Clement I. Walker, Guy Norton, George B. Washburn, Thomas B. Pierce, Leander Hunter.

THE TELEGRAPH AND TELEPHONE.

OBERLIN, OHIO.—The Northern Ohio Telephone Company is extending its line to Norwalk.

CORSICANA, TEX.—The Bell Telephone Company's system has been extended from here to include several towns.

QUINCY, ILL.—The Lewis County Telephone Company is contemplating connecting its line with the Quincy exchange.

PONTIAC, ILL.—The Livingston County Telephone Company has been granted a franchise to do business at Chatsworth.

PEORIA, ILL.—The Fulton County Telephone Company will ask for a franchise to build and operate an exchange in this city.

CUMBERLAND, WIS.—Telephone communication has been established between this city and other points on the new Wisconsin Valley lines.

KEOKUK, IA.—The long-distance telephone service was initiated in this city a few days ago. A reception and entertainment were given in honor of the interesting event.

PORTLAND, ORE.—The Inland Telephone & Telegraph Company will soon begin the extension of its system from Pendleton to Boise, with stations at LaGrande, Union and Baker City. It is expected that the line will be completed by June 1.

BOWLING GREEN, KY.—The Park City Telephone Company is the name of a new concern being organized in this place. It will begin the construction of its system at once, and will compete with the service of the East Tennessee Telephone Company.

ALTON, ILL.—That some independent telephone exchanges in the West are paying investments may be inferred from the fact that the Calhoun Telephone Company, in Calhoun, this State, at its recent annual meeting declared an annual dividend of 8 per cent.

ATLANTA, GA.—A representative of the Southern Bell Telephone Company has been in conference with the manager of the Independent Telephone Exchange, at Carrollton, in regard to the construction of a long-distance telephone line from Atlanta to that place, a distance of 75 miles.

SHEYBOYGAN, WIS.—Wisconsin has fifty-eight telephone companies operating in the State. These pay the State a percentage tax of 2¼ per cent. on their gross earnings, and all companies whose earnings amount to more than $100,000 pay 3 per cent. Last year the taxes from this source amounted to $10,777.

OMAHA, NEB.—It is stated that New York capitalists are endeavoring to secure a telephone franchise in this city. The present telephone charges are regarded as high, and hitherto all attempts at opposition have been defeated. Now that the initiative and referendum is in effect here, it is expected that the new company will gain a foothold through this means.

YPSILANTI, MICH.—In the war which has been going on in this city between the Michigan Bell Telephone Company and the new State Telephone Company the new State Company has gained a victory. It will give the city the free use of six telephones. Bell instruments will be displaced by those of the new State Company, which now has 168 'phones connected.

SAUGATUCK, MICH.—At the recent annual meeting of the Saugatuck & Ganges Telephone Company, it was decided to extend the service. There has been talk of selling the plant to the Ottawa Telephone Company, but it was decided not to do this. The report of the secretary shows that the annual cost of maintaining and operating the plant for the past year has been $10.25 per instrument.

ASHLAND, OHIO.—The annual meeting of the Farmers Telephone Company was held recently. The company owns about 70 miles of line, and reaches Widowville, Hayesville, Jeromeville, Mohican, McKay and Loudonville. At the McKay exchange connections are made with twenty-five of the most prosperous farmers in that neighborhood. The company now has about seventy-five members. Mr. J. C. Andrews was elected president; J. W. Covert, secretary and treasurer.

ELECTRIC LIGHT AND POWER.

JEFFERSON, IND.—The Jefferson Electric Light, Gas, Heating & Coal Company has elected the followng officers: E. C. Eaken, president; A. A. Swartz, secretary and treasurer; N. H. Myers, T. J. Lindley and J. E. Taggart are the other directors.

BEARDSTOWN, ILL.—At a meeting of the board of directors of the Beardstown Electric Light & Power Company, it was decided to thoroughly overhaul the entire plant and double its capacity. A new engine and boiler will be put in and other improvements made.

COLUMBIA, PA.—At the meeting of the Columbia Electric Light & Power Company, the following-named officers were elected to serve during the ensuing year: Dr. Alexander Craig, president; Dr. S. A. Bockius, secretary; Ed. B. Eckman, treasurer; A. Z. Staman, superintendent.

TOLEDO, OHIO.—In view of the fact that the present contract for electric lighting expires December 31, 1899, the question "why can't the city undertake to do its own lighting" has been raised. This sentiment is expressed in the message of Mayor Jones to the City Council.

HARRISBURG, PA.—At the annual meeting of the Harrisburg Electric Company the following named gentlemen were elected officers: E. Z. Wallover, president; Charles H. Kintner, general manager; H. W. Stone, secretary and treasurer; W. R. Fitzpatrick, superintendent and electrician.

NORWOOD, OHIO.—The capacity of the electric light plant has about reached its limit, and as there are numerous demands for lamps, it is proposed to increase the plant. A proposition to issue $20,000 additional bonds for this purpose will, in all probability, be submitted to a vote of the people at the spring election.

UTICA, N. Y.—At the annual meeting of the Utica Electric Light Company recently held, the following-named gentlemen were elected officers for the ensuring year: President, H. D. Pixley; first vice-president, William E. Lewis; second vice-president, T. Solomon Griffiths; secretary, treasurer and general manager, M. Jesse Brayton.

PORTLAND, ME.—At the annual meeting of the Consolidated Electric Light Company, of Maine, which was held in this city, the following-named gentlemen were elected officers for the ensuing year: President, Weston F. Milliken; vice-president, Frederick A. Gilbert; treasurer, William R. Wood; clerk and manager, George E. Raymond.

NORRISTOWN, PA.—Sealed proposals will be received by the finance committee of the Borough Council for an electric light plant for the Borough of Norristown, Pa., until 3 P. M., February 9 next. Specifications and drawings will be delivered to bidders on and after January 25. Furthers particulars may be obtained from Dr. W. A. Drysdale, consulting engineer, Hale Building, Philadelphia.

OMAHA, NEB.—The Thomson-Houston Electric Company, of this city, has made several important improvements in its plant. It has completely remodeled its building and plant during the past year. New engines and dynamos were installed at a cost of $100,000, thus bringing the station up to date. By the changes the capacity of the plant in both arc and incandescent service was greatly increased.

LEROY, N. Y.—It has been discovered that the issue of $40,000 in bonds for the purpose of establishing an electric light and gas works in this place cannot be issued at the present time, owing to certain provisions in the law under which the bonds were advertised for sale, which appear to render the sale invalid. It is likely that the taxpayers will again have to vote on the question of issuing bonds for this purpose.

WEST CHESTER, PA.—The Oxford Electric Light & Power Company elected officers at its recent meeting. The following-named gentlemen will direct the affairs of the company during the next year: D. M. Taylor, J. E. Ramsey, H. A, Menough, Clem. McCormick, J. D. Burns, D. W. Chandler, E. H. Rollins, S. W. Wilson, M. E. Snodgrass.

DENVER, COL.—A large electric power development scheme is being engineered in this city. It is proposed to use the South Platte Canal & Reservoir Company's property in connection with the water rights, now owned by the Denver Union Water Company. Water will be stored in the mountains about 40 miles from Denver, and an electric power plant will be erected at the mouth of Platte Canyon at a point about 20 miles from this city. The plant will have a capacity of about 17,000 horse-power.

GRAND RAPIDS, MICH.—The board of directors of the Twin City Electric Company has elected the following named officers: President, F. J. Wood; treasurer, George M. Hill; secretary, E. P. Arpin. A franchise from the cities of Grand Rapids and Centralia will be applied for. It is the present purpose of the board of directors to prepare the new company, not only for furnishing light in the two places, but also to furnish cheap power to any and all manufacturing concerns. The Twin City Electric Company is capitalized at $15,000. Its plans are not yet matured enough to state when it will be in readiness to furnish light and power, but it is expected that this time will soon be reached.

LEWISTON, IDAHO.—The Lewiston Light Company, Limited, now has a steam plant at Lewiston, which is loaded to more than it was designed to carry. This plant is to be discontinued and a new plant built on Asotin Creek, distant 12 miles. Asotin Creek is mountain-fed, and has a fall of 2 feet in 100, and a minimum flow of 100-foot seconds. The company contemplates the ultimate use of the entire flow under a head of 85 feet net. A ditch and flume will be constructed with this end in view, although the present installation will be limited to a 300-kw three-phase alternating current generator, direct-connected to a turbine wheel. This company has the contract for the public lighting in Lewiston, which is the largest and wealthiest city of Idaho. The Lewiston (Idaho) Light Company, Limited, has engaged Mr. Eleazar Darrow, E. E., of Spokane, Wash., to prepare the hydraulic and electric plans for its new plant. Mr. Darrow is also professor of mechanical and electrical engineering in the Washington Agricultural College and School of Science, Pullman, Wash.

THE ELECTRIC RAILWAY.

PHILADELPHIA, PA.—The Select Council have granted permission to the Southwestern Street Railway Company to construct an electric railway on certain streets of the city.

ATLANTA, GA.—It is proposed to construct a trolley line between Atlanta

and Douglasville, a distance of 35 miles. Colonel James is agent for the capitalists who propose to construct the road.

JERSEY CITY, N. J.—The North Hudson County Railroad Company has petitioned the city for permission to introduce the trolley system on its Grove Street line, which is now operated by horses.

MIDDLETOWN, MD.—The Myersville & Cotoctin Electric Railway Company has been organized to build a line from Middletown to Myersville, a distance of 5 miles, as a feeder to the Frederick & Middletown line. It will cost $36,000.

CUMBERLAND, MD.—Messrs. John M. Burchnell, of Moundsville, W. Va., and A. Flick, of Altoona, Pa., have employed Mr. B. A. Richmond to secure them the right of way for an electric railway from this city via Frostburg, to Piedmont and Westernport.

CHATTANOOGA, TENN.—The old board of directors of the Chattanooga Electric Street Railway Company was re-elected at the annual meeting of the stockholders of the company, held a few days ago. Mr. J. W. McFarland was appointed superintendent of the company's lines.

MT. VERNON, N. Y.—It is announced by Herbert T. Jennings, treasurer of the New York, Elmsford & White Plains Railroad Company, that after February 1 the company will be known as the Tarrytown, White Plains & Mamaroneck Railroad Company, and that the line will be extended to Mamaroneck as soon as franchises and right of way can be obtained.

OTTAWA, ILL.—The Ottawa Electric Street Railway Company has been placed in the hands of a receiver. The company was organized last year with a capital stock of $100,000. Ex-Mayor L. W. Hess has been appointed receiver. The line will be operated by the receiver under order of the court.

SCHENECTADY, N. Y.—Plans for the largest direct current railway generator ever made are being prepared at the General Electric Company's works. It will be of 4000 horse-power, and weigh 87 tons. It is to be constructed for the Louisville Street Railway Company, Louisville, Ky. The General Electric Company has also received an order for thirty-six 175-hp motors for the Metropolitan West Side Elevated Railroad in Chicago.

SOMERVILLE, N. J.—On January 24 a franchise was granted by the Somerville Town Commissioners to the New York & Philadelphia Traction Company to build its road through the town. This action shuts off the Brunswick Traction Company, which has been at war with the former company for some time over the right of way through the towns of Somerville and Raritan. The Brunswick Company had already built several miles of its proposed line.

NEWARK, N. J.—It was announced on January 27 that the consolidation of all the trolley roads in New Jersey, under the name of the Union Traction Company, would soon take place. The capitalization is variously estimated at between $50,000,000 and $100,000,000. The last step in the plans, it is stated, was the cessation of hostilities between the New York & Philadelphia Traction Company and the Brunswick Traction Company, on January 26, over the right of way through the town of Bound Brook. Franchises are now held by the various companies for through lines between New York, Greenwood Lake, Easton and Philadelphia.

Obituary Notes.

THE HON. BENJAMIN BUTTERWORTH, United States Commissioner of Patents, died at Thomasville, Ga., on January 16, after an illness of several weeks. Major Butterworth was born in Ohio in 1839, and was appointed commissioner of patents on April 1, 1897. He held the same position in 1883. Major Butterworth was highly esteemed by all his personal and professional acquaintances. The remains were buried in Washington on January 19.

OLIVER BLACKBURN SHALLENBERGER, whose death was briefly announced in the last issue of The Electrical World, was born at Rochester, Pa., in 1860. In 1877 he entered the United States Naval Academy as a cadet. From the very start he took a leading position in his class, and at this early date displayed that remarkable judgment which was such a large factor in his success. About this time Prof. N. M. Terry had begun to develop that excellent course in physics which has added so much to the reputation of the Naval Academy, and Mr. Shallenberger had no sooner entered upon that study than he began to take a special interest in the branch of electricity. His inclination from the first was toward original and experimental work. Mr. Shallenberger's course at the Naval Academy was contemporary with that of Duncan, Sprague, Hasson, Wilkes and several others, whose names are well known among electricians. After his graduation, in 1881, he made a cruise in the Mediterranean; he returned to the United States in 1883 and resigned from the naval service the following year in order to give his whole attention to the science of electricity. In 1884 he became connected with the Union Switch & Signal Company, of Pittsburg, as assistant in its newly organized electric light department. His ability was at once apparent, and in the following summer he was selected to take charge of the setting up and operation of the Gaulard & Gibbs apparatus, imported from Europe by Mr. Westinghouse. At this time his practical acquaintance with alternating currents began. After Stanley's experiments at Great Barrington, Mass., and other experiments conducted at Pittsburg by Mr. Shallenberger, the alternating-current system was adopted; the Westinghouse Company was organized, and he was appointed chief electrician. Mr. Shallenberger was one of the earliest to apply the theories then known about alternating currents to practical operation. In all his work he mingled his brain with his labor. He was the first one in America to succeed in coupling alternating-current generators in multiple. The system used for incandescent street lamps in series, with a shunt of high self-induction around each lamp, was one of his early inventions. Probably his most beautiful conceptions are exhibited in his electric measuring instruments. In 1891 Mr. Shallenberger was obliged to go to Colorado Springs on account of ill health, where he has since spent the winters, coming East to his home and laboratory in Rochester during the summer months. In the early part of 1897 Mr. Shallenberger organized the Colorado Electric Power Company. He was the president of this company, and acted as consulting engineer for the Westinghouse Electric & Manufacturing Company. He left the East for Colorado for the last time, in the latter part of October, 1897. It may be truly said that, with the name of Shallenberger omitted, the history of practical electricity would not be complete. And now, reflecting on what he accomplished in the short space of thirty-eight years, we wonder what inventions, what discoveries might still have come from such a rare and enviable intellect. His was a charming personality. Death occurred at about 8 o'clock in the evening of January 24, after an illness of several weeks.

Personal Notes.

MR. CYRUS ROBINSON, formerly connected with the Ridgway Dynamo & Engine Company, Ridgway, Pa., is now located in Portland, Ore. Mr. Robinson is connected with the Hammond Manufacturing Company as engineer and vice-president. This company intends to manufacture electrical apparatus and equipments for mining.

MR. GUSTAV BISSING has resigned as principal examiner of Electrical Division A of the United States Patent Office, his resignation to take effect on January 31. Mr. Bissing will form a partnership with Mr. Joseph Lyons, electrical expert and solicitor, Washington, D. C. The new firm will carry on the practice of patent law in all its branches, and will have its headquarters in the McGill Building, 908 G Street, N. W., Washington, D. C.

MR. F. S. TERRY GOES TO THE WESTON ELECTRICAL INSTRUMENT COMPANY.—Mr. F. S. Terry, of Chicago, who is well known to the electrical fraternity at large, through his active and successful association with various electrical enterprises in Chicago, has left the "Windy City" to accept an important position with the Weston Electrical Instrument Company, Newark, N. J. Mr. Terry, we understand, will not sever his connection with the Sunbeam Incandescent Lamp Company.

MR. FRANK A. ROGERS has resigned his position as general manager of the Card Electric Company, Mansfield, Ohio, which position he has occupied for the past two years. It will be remembered that Mr. Rogers was in the service of the Brush Electric Company continuously for a period of fourteen years, and afterward with the Short Electric Railway Company. The best wishes of The Electrical World follow Mr. Rogers into such new enterprise as he may undertake.

Legal Notes.

THE RAILWAY MOTOR SUSPENSION DECISION.

In the last issue of The Electrical World a brief announcement was made of Judge Wheeler's decision in the case of the Sprague Electric Railway & Motor Company against the Union Railway Company, et al. The case possesses considerable interest to electric railway people, and for this reason we give the judge's opinion in full, as follows:

"This suit is brought upon patent No. 324,892, dated August 25, 1885, and granted to Frank J. Sprague for an electric railway motor consisting of a field magnet journaled on the axle of the driving wheels at one end, and hung upon a spring from the truck, or the car body, at the other, and carrying the armature shaft upon its pole pieces parallel with the shaft of the driving wheels, and connected to them by gearing. The specification as to this arrangement says:

" 'The armature being carried rigidly by the field magnet, these two parts must always maintain precisely the same relative position under every vertical or lateral movement of the wheels or of the car body; and as the field magnet which carries the armature is itself centered by the axle of the wheels to which the armature shaft is geared, the engaging gears also must always maintain precisely the same relative position. At the same time the connection of the entire motor with the truck is through springs, so that its position is not affected by the movements of the truck on its springs.

"The claims in question are:

"2. The combination of a wheeled vehicle and an electrodynamic motor mounted upon and propelling the same, the field magnet of said motor being sleeved upon an axle of the vehicle at one end and supported by flexible connections from the body of the vehicle at the other end, substantially as set forth.

"6. The combination with a wheeled vehicle, supported upon its axles by springs, of an electro-dynamic motor flexibly supported from such vehicle, and centered upon the driving axle thereof, substantially as set forth.

"9. The combination with a wheeled vehicle, of an electro-dynamic motor centered upon the driving axle thereof at one end, a spring support for that end of the motor from the truck or body of the vehicle, and relieving axle wholly or partly of dead weight, and a spring support for the other end of motor from the truck or body of vehicle, substantially as set forth.

"This patent was before the Circuit Court of Appeals for the Eighth Circuit in Adams Electric Railway Co. v. Lindell Railway Co., 77 Fed. Rep., 432, which was brought upon patent No. 300,827, dated June 24, 1884, and granted to A. Wellington Adams for improvements in electric motors, against structures made according to this patent as infringements. The position of Sprague's invention with reference to prior structures, inventions and patents is there well and comprehensively set forth by Judge Sanborn in the opinion of the court; and the decree dismissing the bill appears to have been affirmed because, in short, Sprague's invention was independent of Adams'. And if Sprague's patent was for merely hanging and centering one end of the motor of a carriage upon the axle of the driving wheels, and suspnding the other by a spring from the body of the vehicle, or the truck, it would be shown from that case to be wholly lacking in novelty and void. He was not a pioneer here, and could have a valid patent for only what was new in his method of making the power of the electrical current turn the driving wheel. No one had before, however, hung a field magnet at one end upon the axle of the driving wheels, and at the other upon a spring from the body of the car, or the truck, and an armature axle upon the pole pieces of the magnet, parallel with and geared to the axle of the driving wheels for driving a car by a current of electricity. This combination simplified greatly the required structures, improved their results and came into immediate use. The invention of it seems to well support these claims of the patent.

"The defendant's structures differ in some respects from those of the patent, but have all these parts working together in the same relation to each other, for the same purpose and producing the same result. They are altered by the addition of a joint in the motor, and of another spring to help carry it, but not by dispensing with any of the parts; they are improved upon, but not departed from. The defendant's improvements are not made independent of and clear from Sprague's, but upon his; and his patent appears to be infringed by this taking of his invention to improve upon.

"Decree for plaintiff, Hoyt H. Wheeler. Frederick H. Betts, for plaintiff; Charles F. Mitchell, Henry B. Brownell, for defendants."

Trade and Industrial Notes.

MESSRS. DE VEAU & CO. moved their offices and factory on February 1 to No. 27 Rose Street, New York City. Their former place of business was at 32-34 Frankfort Street.

MESSRS. PATTERSON, GOTTFRIED & HUNTER, LTD., 146-150 Centre Street, New York, have just issued a folder illustrating and describing the advantages of the McClelland oil purifier.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., has elected the following named officers: President, William F. Bossert; vice-president, H. P. Crouse; secretary and treasurer, Frank G. Scofield.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, at its annual meeting, recently held, elected the following officers: George Bullock, president; J. S. Neave, vice-president; and James W. Bullock, secretary.

MR. DUNCAN BOND, 1651 Lawrence Street, Denver, Col., manufacturers' agent for railway, mechanical and electrical supplies, writes that he is now in a position to give two or three reputable makers of electrical supplies good representation in the Denver market.

TRADE CATALOGUES WANTED.—Mr. G. H. Nickerson, of Idaho Falls, Idaho, is contemplating the building of an electric light plant at that place, and desires to receive catalogues, price lists, etc., from dealers in dynamos, motors, wire, electric light fixtures and supplies.

MR. JAMES G. BIDDLE, 910 Drexel Building, Philadelphia, has just issued an illustrated price list of Weston standard voltmeters, ammeters, wattmeters, ohmmeters and galvanometers. Mr. Biddle is selling agent for the Weston Electrical Instrument Company.

MR. HARVEY HUBBELL, Bridgeport, Conn., has just published a very neat catalogue of horizontal tapping machines, riveting machines, screw slotters, speed indicators, etc. Mr. Hubbell manufactures a full line of machinery and tools. The catalogue is very artistically illustrated.

THE W. S. HAINES COMPANY, 136 South Fourth Street, Philadelphia, reports that in January, 1896, there were 25,000 Heintz steam traps in use; 50,000 at the same time in 1897, and 125,000 in January, 1898. This is an increase of 75,000 over last year, and is believed to be the largest ever known in the trap business. This is a sure indication that interest in steam devices is growing.

THE NOWOTNY ELECTRIC COMPANY, 208-212 Lawrence Street, Cincinnati, Ohio, has such great faith in the superiority of its long-burning enclosed-arc lamp that it offers to ship a lamp on fifteen days' trial, and if at the end of that time thorough satisfaction is not given, the lamp may be returned to the company at its expense. This lamp is recommended for use on incandescent circuits.

TREE INSULATORS.—Central station managers will appreciate the swinging-tree insulator, which is manufactured by the Western Electric Company, Chicago. This insulator fully protects the lines from swaying branches without cutting the insulation, and is readily hung by a wire twisted through a hole at the top. These insulators can also be used to support arc light wires when passing under bridges, awnings, iron roofs, etc.

THE GENERAL ELECTRIC COMPANY, in view of the large number of applications made for information, which is embodied in the second part of its recently issued Edison Incandescent Lamp Catalogue, has published this information in a separate sixteen-page pamphlet of small octavo form. This information is of value to all users of incandescent lamps, and the General Electric Company will be pleased to supply copies of the pamphlet on application.

THE WALKER COMPANY has issued a circular on mica insulation. Views of mica insulating rings of all sizes are given, together with motor field coils insulated with this material. Another circular just issued by this company is devoted to the subject of heavy electric railway work. This circular comprises an article on "Electricity as a Motive Power on Elevated Railways," by Prof. S. H. Short, which article was published in THE ELECTRICAL WORLD of August 7, 1897.

MESSRS. SIPE & SIGLER, manufacturers of the Willard storage battery, Cleveland, Ohio, have just closed a contract extending over a period of three years with the Fisher Equipment Company, of Chicago, for Willard storage cells, amounting to $238,000. The cells are to be used for motor-vehicle propulsion. The firm recently filled orders for the Western Union Telegraph Company, for 120 Willard storage cells for Hoboken. N. J.; forty cells for Scranton, Pa.; thirty cells for New Haven, Conn.; twenty-five cells for Newark, N. J., and 343 plates for Ravenna, N. Y.

MESSRS. KIELEY & MUELLER, 7-17 West Thirteenth Street, New York City, have just issued a catalogue of their steam specialties, which include low pressure reducing valves, vacuum pressure reducing valves, back pressure valves, high pressure reducing valves, steam, grease and oil extractors, positive automatic pump governor, standard steam traps and Climax damper regulator. These various devices are very clearly illustrated and described. The catalogue lists many other products of this concern, and gives considerable information of interest to steam users.

AMERICAN ELECTRICAL APPARATUS FOR ENGLAND.—A Schenectady dispatch states that the General Electric Company has just received a large order for thirty-two electric locomotives for the Central London Underground Railway. This contract will affect not only the General Electric Company's works, but those of the Schenectady Locomotive Works as well, for the locomotives will probably be constructed by the latter concern. The engines will have a capacity of 800 horse-power, and will weigh 45 tons each. They will be able to draw a train of five cars weighing about 150 tons, at a speed of 15 miles an hour.

MOTORS FOR DRIVING WOOD WORKING MACHINERY.—The Sprague Electric Company, New York, has secured the contract to install Lundell motors in the new street car works of the John Stephenson Company, Limited, which are now being erected at Elizabethport, N. J. Some forty-three motors will be utilized, ranging in power from 3 horse-power to 40 horse-power, mostly in the large sizes. The motors will be direct-connected, belted or coupled to the latest types of wood working machinery. They will be of the enclosed type, which are so well adapted for such uses in establishments where, of necessity, the atmosphere is filled with dust. The equipment will also include several large-sized Lundell direct-connected exhaust fan outfits. The Stephenson Company's plant will be the largest of its kind in the country, and with the electric power installation, will form an interesting example of the utility of the electric motor in manufacturing establishments.

RHEOSTATS AT THE MILWAUKEE CONVENTION.—We are informed that all of the motors exhibited at the recent convention in Milwaukee of the Northwestern Electrical Association were started with American rheostats, which are manufactured by the American Rheostat Company, Milwaukee, Wis. The American Rheostat Company's exhibit consisted of one one-half-hp 110-volt automatic starter, one 5-hp 110-volt automatic starter, one 7½-hp 110-volt automatic starter, and the front of a 100-hp 110-volt automatic starter; one 5-hp 220-volt automatic speed controller, one 40-kw 110-volt rear of switchboard field rheostat, one 3-kw 115-volt wall type field rheostat, one 10-hp 220-volt reversible elevator controller, one 5-hp 220-volt Perfection starter, one front for a 20-hp 220-volt Perfection starter, and one controller for sewing machine work.

Business Notice.

A FINE VIEW OF PIKE'S PEAK and of Mounts Harvard, Yale and Princeton in the Rocky Mountains can be had from the tourist car of the Midland Tourist Route, which leaves Chicago for California at 10 o'clock every Saturday night from the Chicago, Milwaukee & St. Paul Railway passenger station. For illustrative descriptive circular apply to the nearest coupon ticket agent, or address E. F. Richardson, General Agent Passenger Department, C., M. & St. P. Ry., 381 Broadway, New York City.

Illustrated Record of Electrical Patents

UNITED STATES PATENTS ISSUED JANUARY 25, 1898.
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

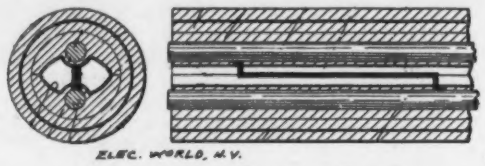
597,782. TELEPHONIC INSTALLATION; G. Ritter, Stuttgart, Germany. App. filed June 11, 1896. The combination with a line circuit extending from a subscriber's station to an exchange station, of a test battery, a clearing out annunciator having operating and restoring coils adapted to act oppositely through the medium of suitable mechanism upon an indicator, an individual annunciator having operating and restoring coils adapted to act oppositely through the medium of suitable mechanism upon an indicator, the restoring coil being included in the line circuit, and connecting plugs provided with contact devices partly fixed and partly loose so as to permit of the connections and the auxiliary operations being effected by the plugs; the said connecting plugs being arranged in the line circuit, a test battery having one of its poles connected with an auxiliary circuit and a shunt through the restoring coil of the clearing out annunciator to certain contact devices of one of the connecting plugs; said test battery having its other pole connected with the operator's telephone set as well as certain contact devices of the connecting plugs through the restoring coil of the individual annunciator in such manner that the connecting plugs, when properly manipulated are adapted to establish the connections and automatically raise the indicator of the clearing out annunciator.

597,785. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed April 16, 1895. The combination with a telephone line, of means for producing a signaling current in the line, and a relay in the circuit responding to such current, a local circuit including a subsidiary line signal controlled by the relay, an auxiliary helix on the relay in the local circuit, means for establishing connection with the line, and switch contacts actuated in the establishment of such connection adapted to interrupt the current through the said auxiliary helix.

597,786. TELEPHONE CIRCUIT; C. E. Scribner, Chicago, Ill. App. filed Dec. 18, 1896. In combination, a source of telephonic undulatory current and a receiving instrument therefor in a closed conducting circuit, two windings of a repeating coil serially included in the circuit, a conductor including a condenser in shunt of the windings of the repeating coil, and a bridge uniting the point of juncture of the windings of the repeating coil with the other side of the circuit.

597,787. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Dec. 18, 1896. The combination with a telephone line and means for determining the flow of current in the line during the use of the telephone, of a magnet responsive to current in the line, an armature therefor, a secondary signal and circuits, including the secondary signal controlled by switch contacts operated by the said armature, a second electromagnet adapted to retract the armature, a circuit including said second magnet, and circuits closed to excite the said magnet in the act of making connection with the line.

597,790. ELECTRIC CABLE; W. S. Smith and W. P. Granville, London, England. App. filed Nov. 1, 1897. An electric cable of insulating material formed with a central longitudinal air space, and with two or more wires



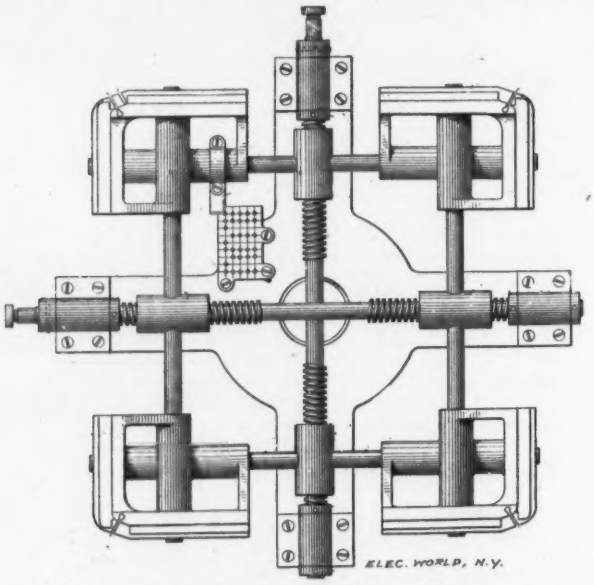
No. 597,790.—Electric Cable.

embedded at distances apart in the insulating material near the inner circumference.

597,795. TARGET; T. Wrench, Metuchen, N. J. App. filed March 15, 1897. In an improved target, a series of independently operating segmental sections collectively forming the target face and respectively comprised in an electric circuit, said sections being adapted to be operated by the impact of the ball to close said circuit, and each section having an annular concave groove in the face thereof, in combination with registering means or devices operated by said electric circuit.

597,799. ELECTRIC RAILWAY; E. C. Crocker, Bridgeport, Conn. App. filed April 23, 1897. In an electric railway system, comprising insulated third-rail sections, a line wire and contact shoe from the car traveling on said sections, the combination of the two series of magnets arranged in horizontally disposed couplets, two contacts in proximity to each couplet, switches within the fields of the magnets of each couplet and capable of being operated in connection with said contacts to close and open the circuits, the magnets of one series being in respective circuits with alternate magnets of the other series when said switches are closed, and connections between the respective circuits and the line wire and rails.

597,816. ARMATURE WINDING MACHINE; C. Eickemeyer, Yonkers, N. Y. App. filed Oct. 30, 1897. In a winding frame for producing armature coils, the combination with a suitable chuck or head plate, of four angular



No. 597,816.—Armature Winding Machine.

coiling plates arranged to afford a rectangular outline and four right and left-hand screws coupled together in pairs, and operatively coupled to said coiling plates for varying the relative positions of said plates, according to the size of the coil desired.

597,848. TROLLEY; G. A. Hall, Portland, Me. App. filed Feb. 6, 1897. In a trolley, the combination with the head having an annular flange, an axial recess and an annular groove, the latter being located between the recess and flange; of the stock bearing at its lower end in the axial recess, a disc secured to said stock and having an arm projecting through a slot in the annular flange, anti-friction balls, interposed between the disc and annular groove of the head; together with a spring, a cord connecting the spring to the arm of the disc and guides between which the cord passes.

597,855. SYSTEM OF ELECTRICAL DISTRIBUTION; H. Linton, Altoona, Pa. App. filed May 7, 1894. A system of electric distribution, comprising a series of separated contacts independent of the track rails, and arranged to be engaged by a traveling contact on the car, a main conductor having a branch conductor leading to each contact, a wire leading from the branch to the ground, and a magnet arranged to automatically make and interrupt the circuit through the contact to ground, and thereafter connect the main conductor to the contact.

597,891. ELECTRICALLY ACTUATED LOCK FOR BICYCLE RACKS; F. V. Walstrom and J. Erickson, Chicago, Ill. App. filed Nov. 9, 1896. In a lock, the combination of a locking mechanism, an alarm mechanism, a relay arranged to control the alarm mechanism, and a normally closed electric circuit arranged to control the relay.

597,949. RAIL CONNECTOR; J. Bryan, Pittsburg, Pa. App. filed June 12, 1897. A rail bond for rails having in combination a series of metal plates arranged approximately parallel therewith, but separated from each other, and metal blocks adapted to be secured to the rails, a portion of the metal of the blocks intercalating with the metal plates, thereby securing automatic electric connection between each plate and the blocks.

597,969. SAFETY FUSE; L. A. Ferguson, Evanston, Ill. App. filed May 24, 1897. A safety fuse having broad ends to engage the conductor terminals, said ends being connected by an arch, a small portion of the length of such arch being contracted to constitute the point at which the rupture of the fuse will occur, the portions of said arch adjacent to the fuse terminals being expanded.

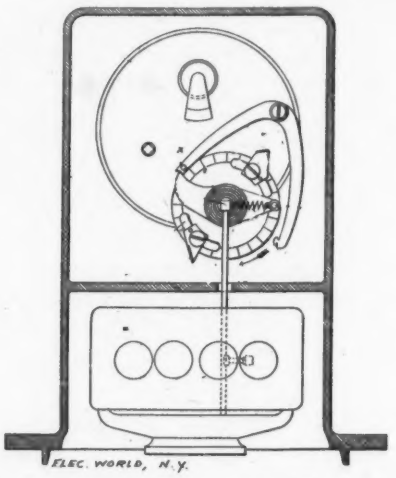
597,979. ELECTRIC SWITCH; J. L. Hinds, Syracuse, N. Y. App. filed Feb. 1, 1896. In an electric switch the combination of a base to which the switch terminals are secured, a blade for closing the circuit between the terminals and a back support consisting of a slotted tube to which the blade is removably secured.

597,985. ELECTRIC METER; G. Kapp, Berlin, Germany. App. filed Nov. 19, 1897. In an electricity meter apparatus a supplemental apparatus or device for permitting the consumption of energy to be metered or charged for at different rates for different hours of the day, and means for throwing the same into and out of operation.

598,001. ELECTRIC SWITCH; J. R. Newell, Titusville, Pa. App. filed Sept. 15, 1897. A pivoted bar of insulating material, conducting plates at each end of the bar provided with projecting extremities, oppositely located upper and lower pairs of binding posts at each end of the bar provided with plates adapted to embrace the projecting extremities of the conducting plates, and to be electrically connected thereby, a pivoted plate above the bar and intervening springs secured to the bar and to the pivoted plate respectively.

598,033. ELECTRIC SIGNALING DEVICE; E. A. Stout, Ja., Philadelphia, Pa. App. filed March 23, 1897. A signaling device, comprising a plurality of contact plates and conducting plates, and conducting wires connecting therewith, a rotatable push button having an arm adapted to be brought into engagement with any one of the plates, a bolt having one end projected into a bore in the bottom, and a spring mounted upon the bolt and performing the double function of holding the contact arm normally out of engagement with the plates, and forming an electric conductor between the main and the contact arm.

598,049. ELECTRIC BURGLAR ALARM SYSTEM; C. Coleman, Chicago, Ill. App. filed Dec. 14, 1896. In an alarm system the combination with a source of E. M. F. within the protected district, of a responsive device controlled thereby, an alarm adapted to be actuated by said responsive device, means for varying the E. M. F. of said source and a compensating device situated at the alarm station and acting in unison with said E. M. F., varying means for counterbalancing the effect upon the responsive device of the



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normal variations of E. M. F. to prevent the giving of an alarm during said normal variations.

598,062. DEVICE FOR PREVENTING ACCIDENTS ON RAILROADS; H. Biermann, Breslau, Germany. App. filed April 6, 1896. In a device for preventing railroad accidents through break or loosening of rails, the combination of a current generator arranged in the train, with a main line circuit adapted to be put in electrical connection with the current generator, and consisting of the rails of the track and divided in several fields, each field being connected by means of two wires with a contact device, adapted to be put out of the circuit of the main line, a secondary line circuit comprising wires insulated from each other at the end of each field of the main line, said circuit being connected with the main-line circuit through the contact device and a secondary conductor on the cap connecting the terminal wires of the current generator, and containing a resistance and the alarm and safety apparatuses of the train.

598,063. ELECTRIC BURGLAR ALARM SYSTEM; C. Coleman, Chicago, Ill. App. filed Dec. 14, 1896. In an alarm system, the combination with a protective circuit of an individual circuit, a responsive device subjected to the combined action of the currents flowing in the two circuits, an alarm controlled by said responsive device, and a multiple permutating resistance for each of said circuits, each comprising a number of units of resistance and a plurality or multiple of circuit changing arms or elements conjointly acting to include said units of resistance in various and successive orders.